From Containers to Content to Context: Digital Library Architectures for Knowledge Generation

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Overview

The Poet, the Library and the Scriptorium
How libraries and content were once closely connected

The Gutenberg Parenthesis opens ...
Dissociation of container and content in the print paradigm

... and closes again
The end of the print paradigm

Documents, Data and Scholarship

... into content, into context ...

An Opportunity for Libraries ...

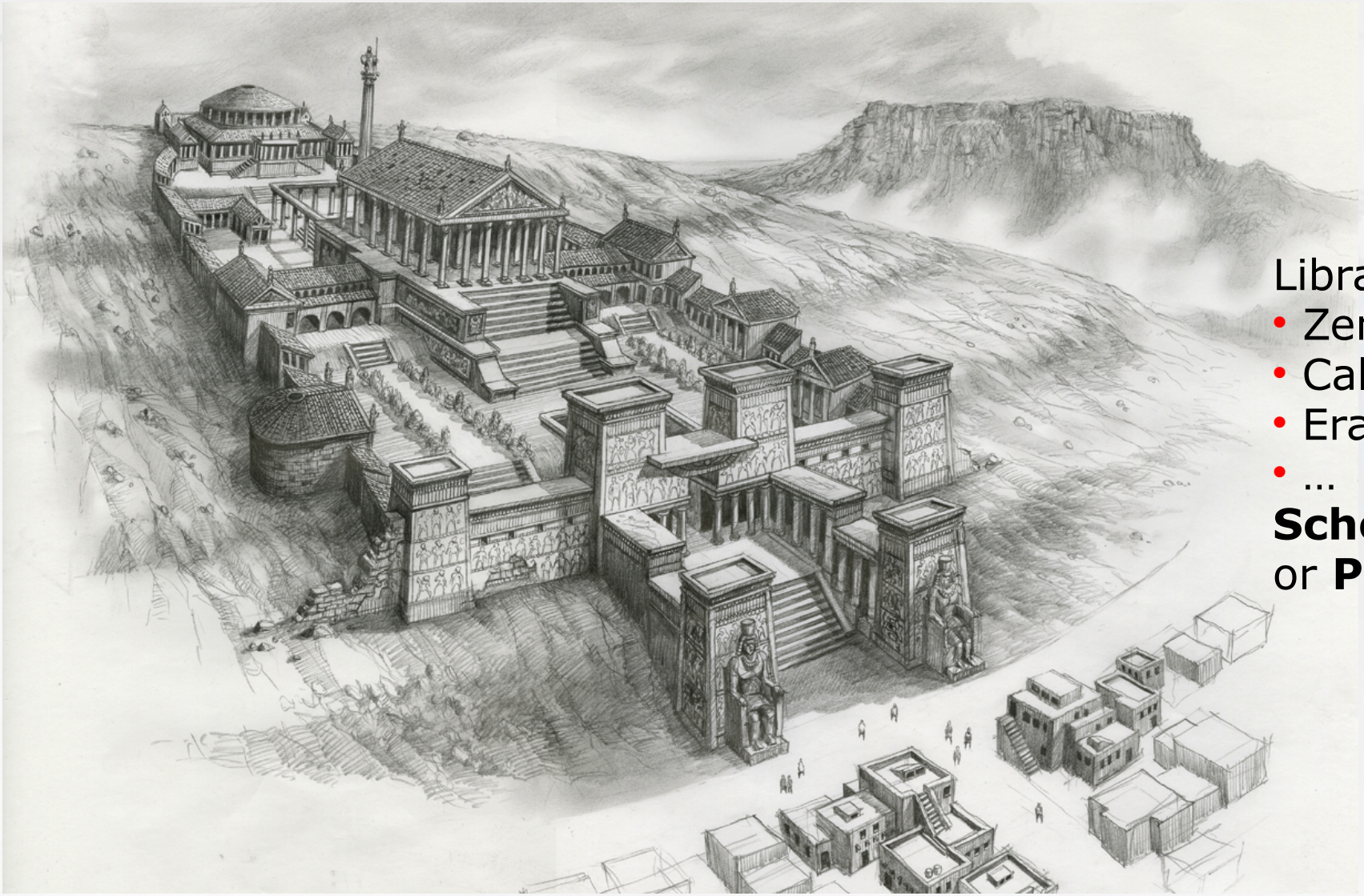
... and what they need to change do to be up to it

... into Knowledge: signification, relevance and 'value'

The Poet, the Library and the Scriptorium

How libraries and content were connected before the Gutenberg Parenthesis

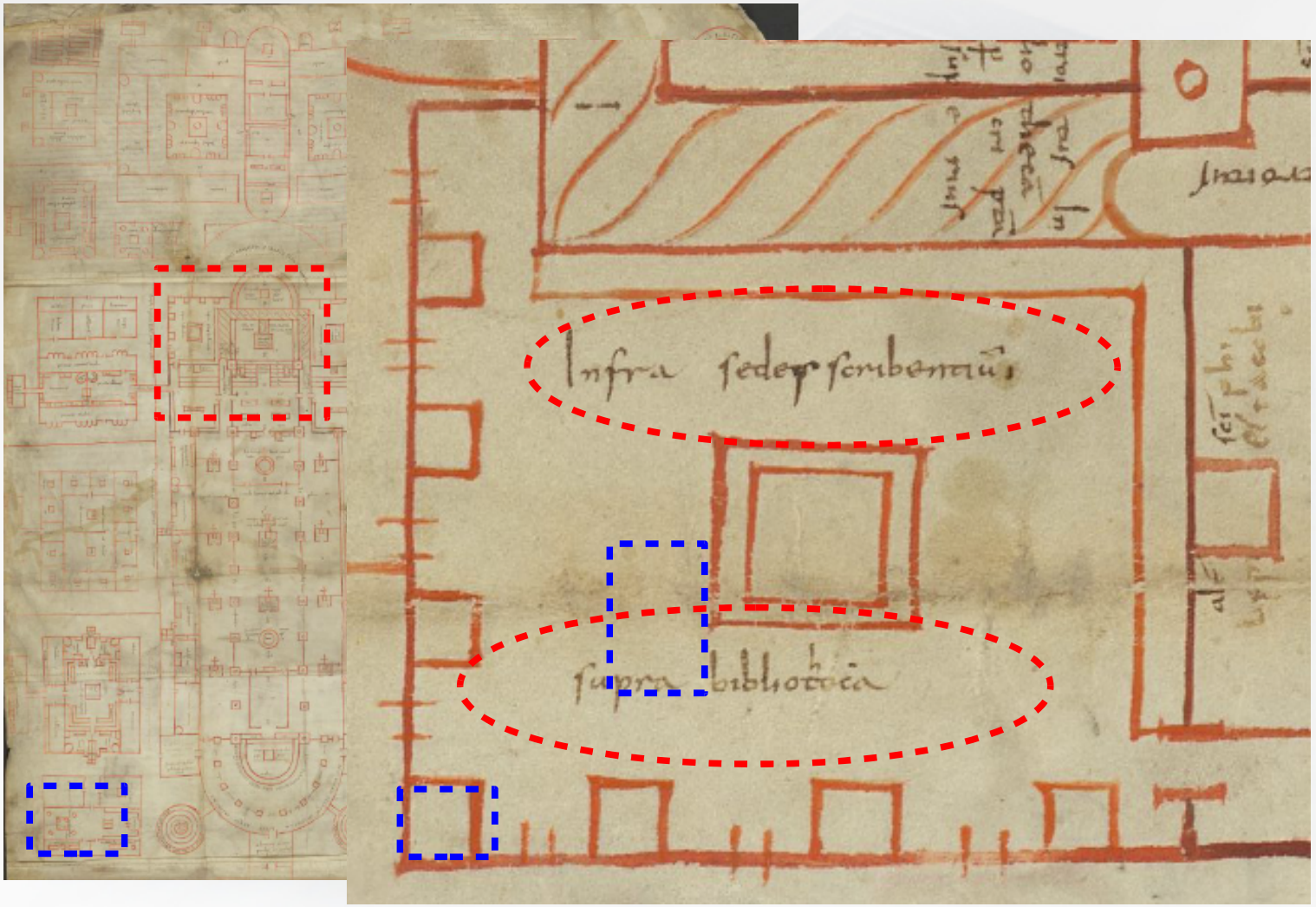
Long before the Parenthesis: Alexandria



Librarians:
- Zenodotus
- Callimachus
- Erathosthenes
- …

Scholars and / or **Poets**

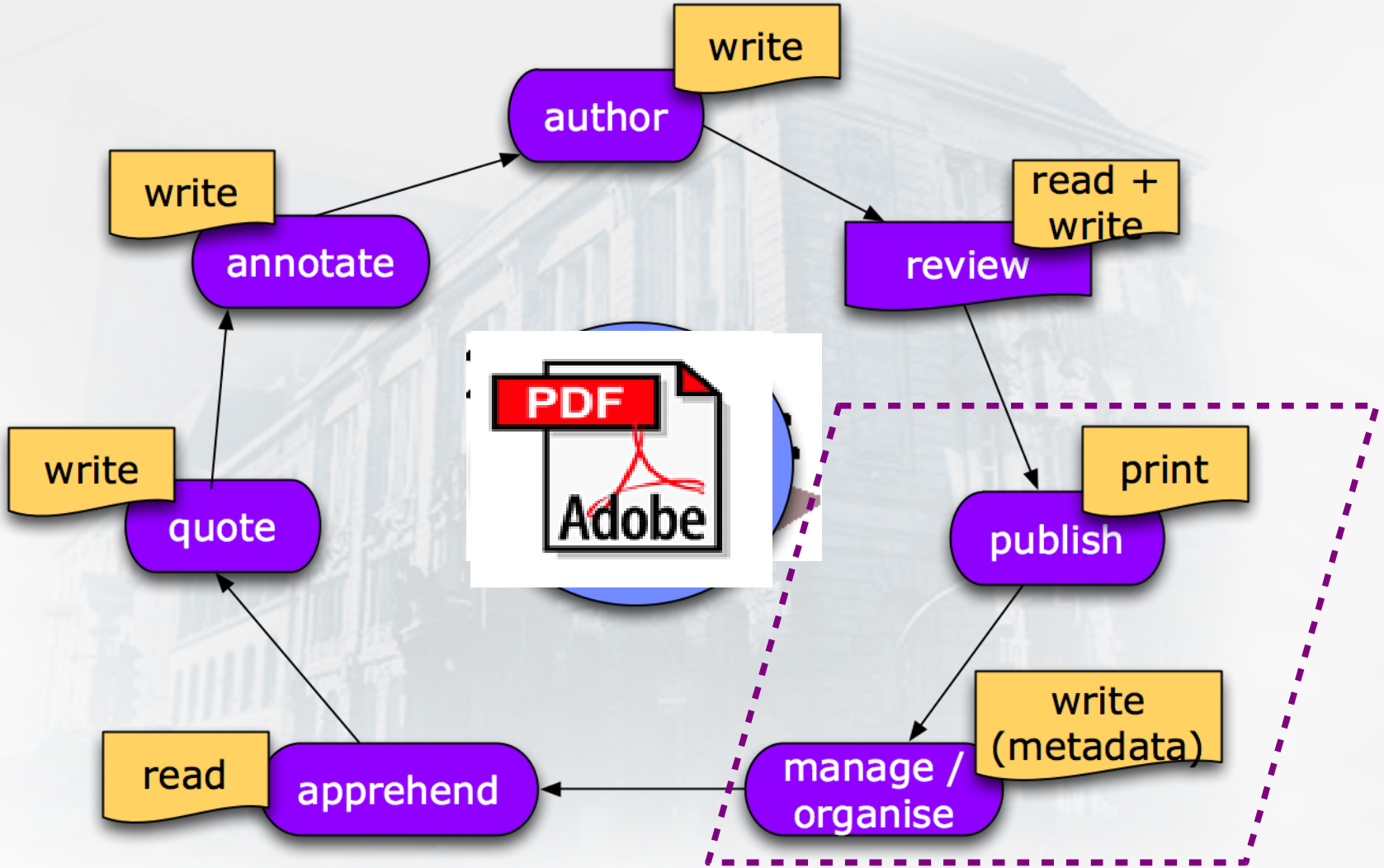
Before the Parenthesis: St. Gall



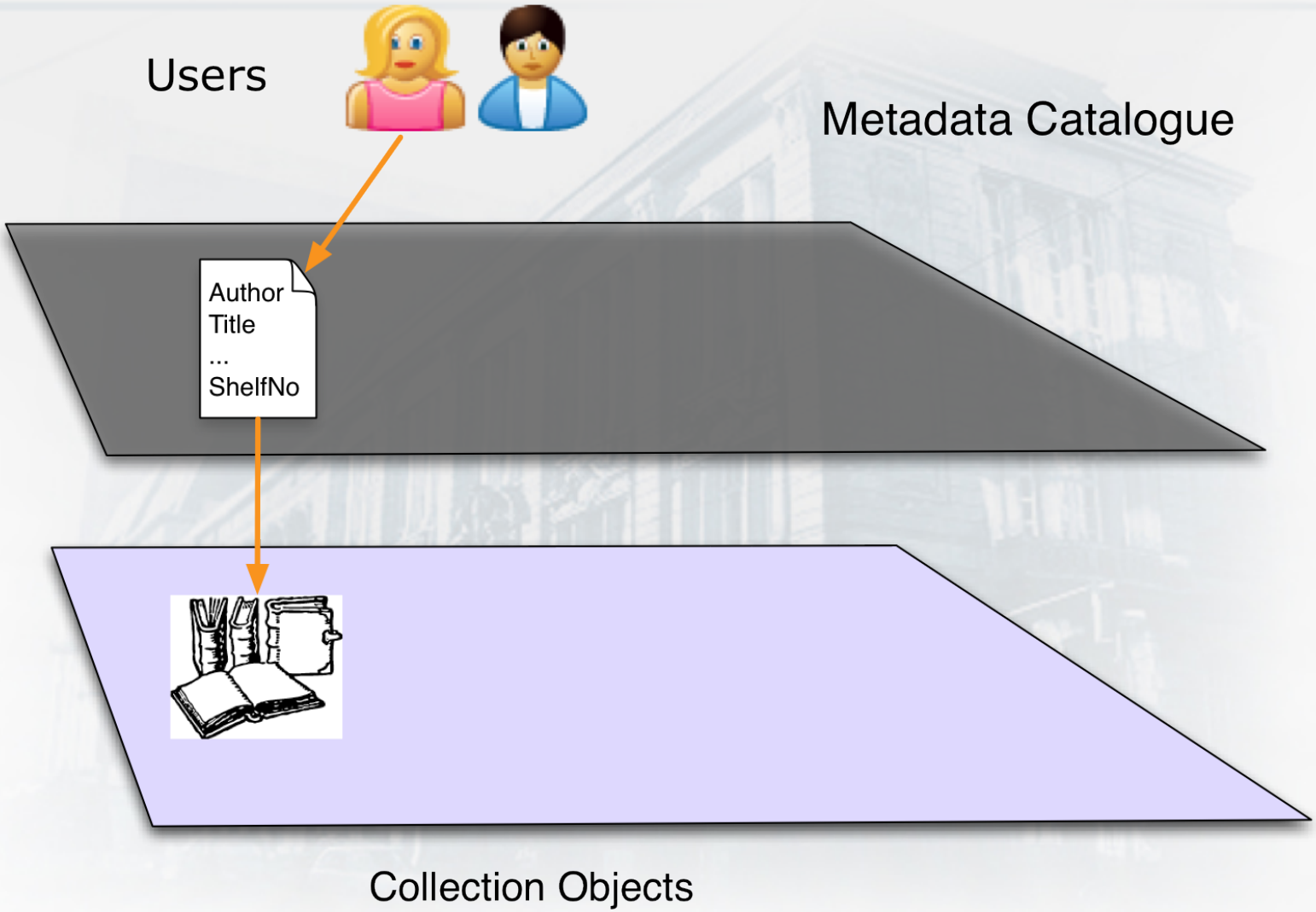
The Gutenberg Parenthesis Opens …

Dissociation of container and content in the print paradigm

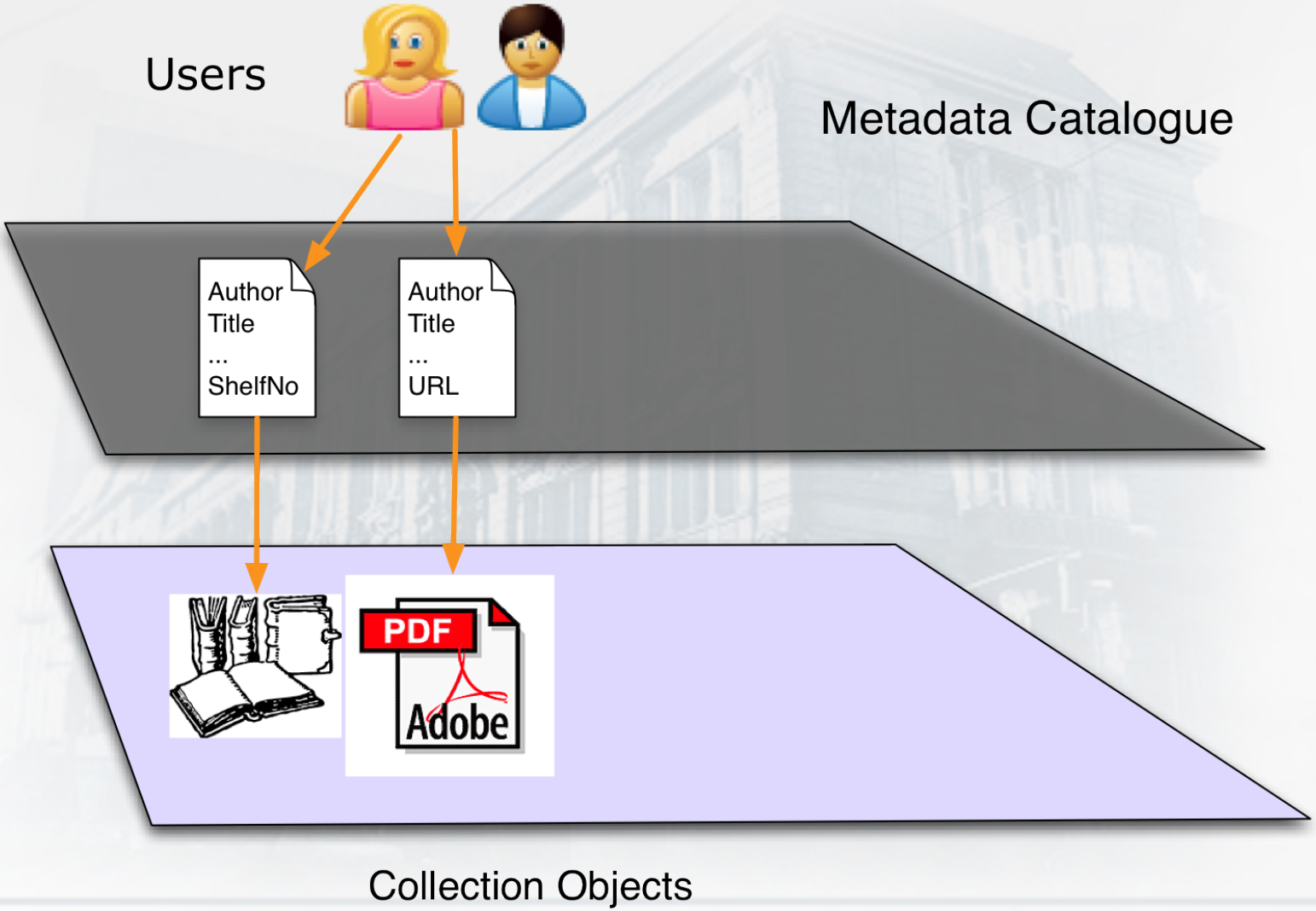
Dissociation of Roles in the Gutenberg galaxy



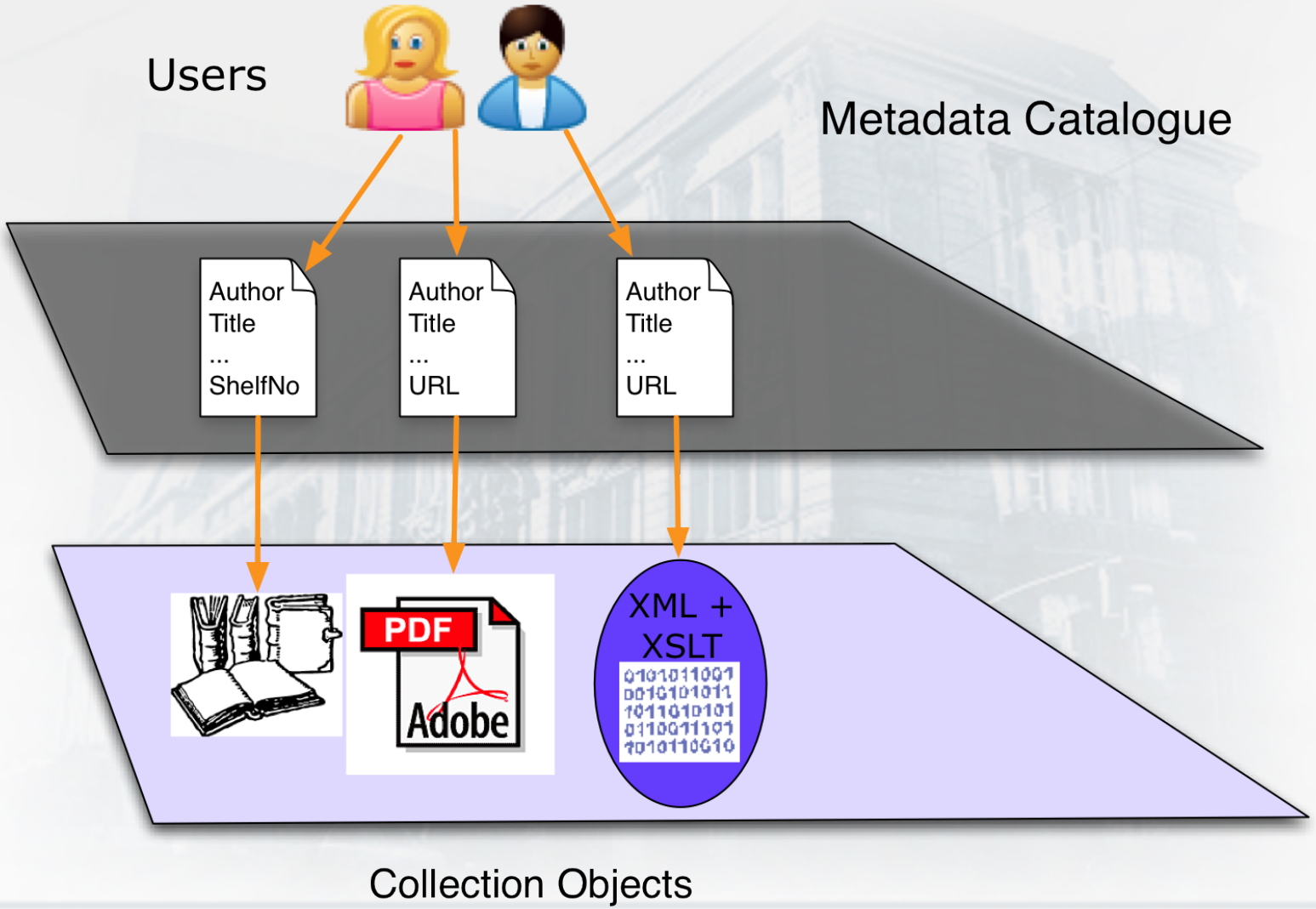
Catalogue Based Library Functional Axioms (1)



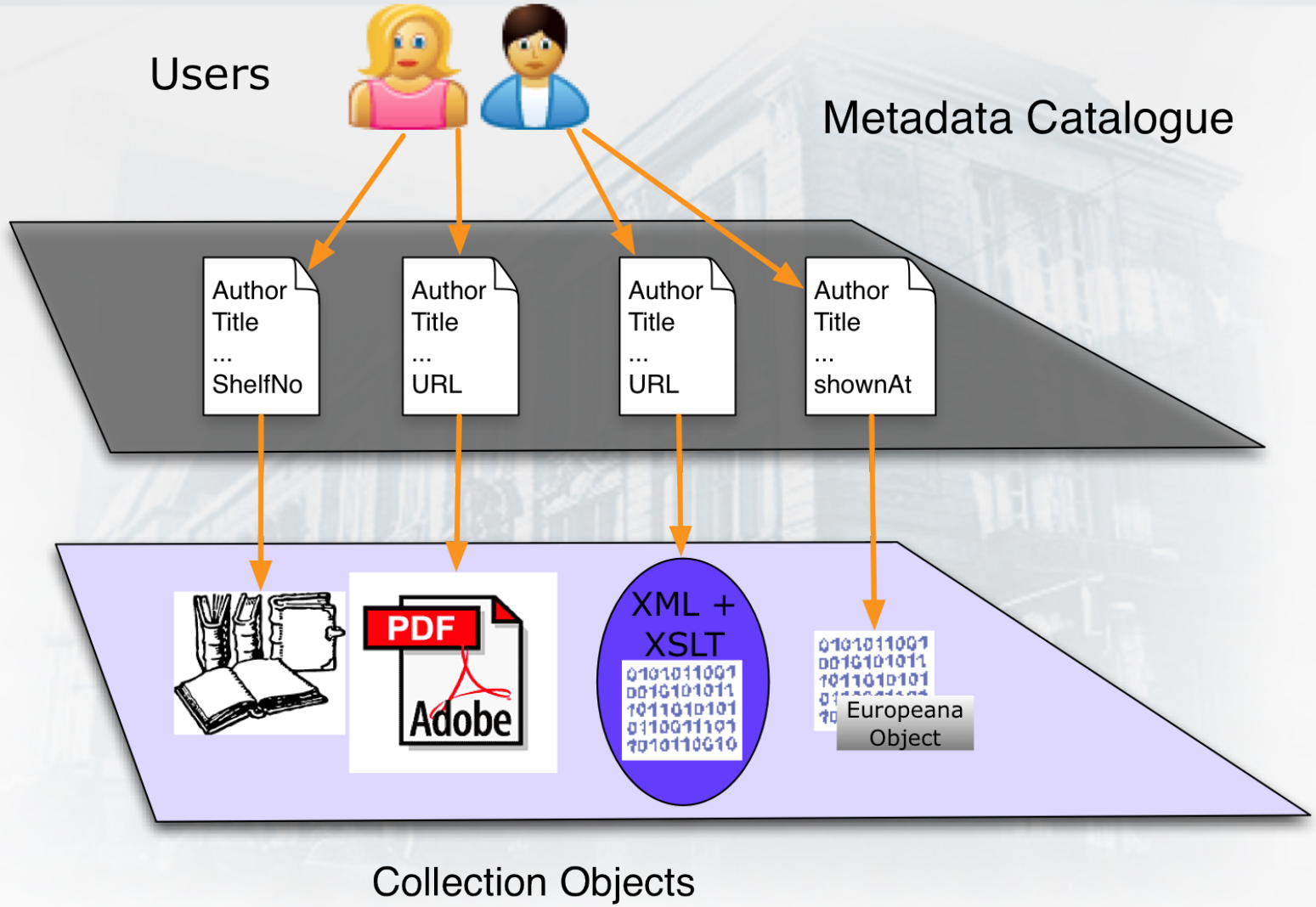
Catalogue Based Library Functional Axioms (2)



Catalogue Based Library Functional Axioms (3)



Catalogue Based Library Functional Axioms (4)



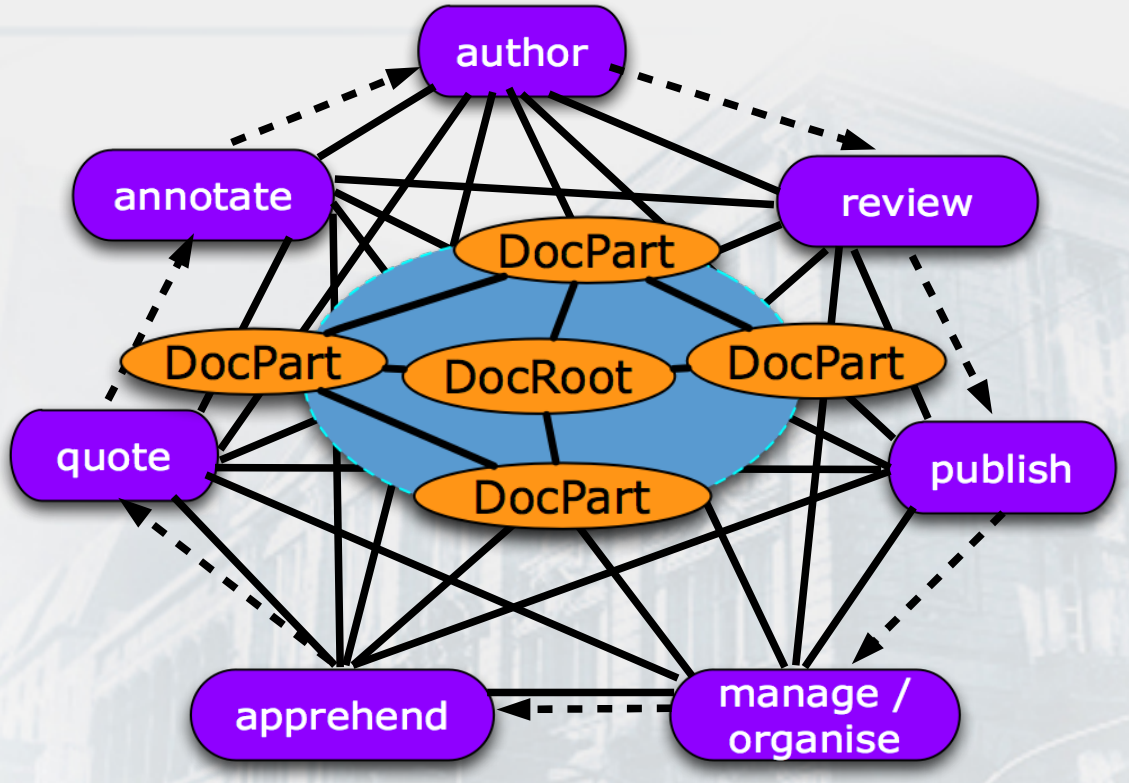
Library Functional Principles (5)

- **Mediating access** to information objects via **catalogues**
- **Mediating links** as pointers from metadata to objects
- Objects are part of a library **collection**
  - An object to be used within a library typically is part of this library's collection
- Internal processing logic: focus on
  - objects as information **containers**,
  - not so much on the **content** of these containers
  - and accordingly **cataloguing** is focussed on **container attributes**
- Functional macro-primitives are **ingestion**, **storage**, **description** and **retrieval** of information containers

… and closes again

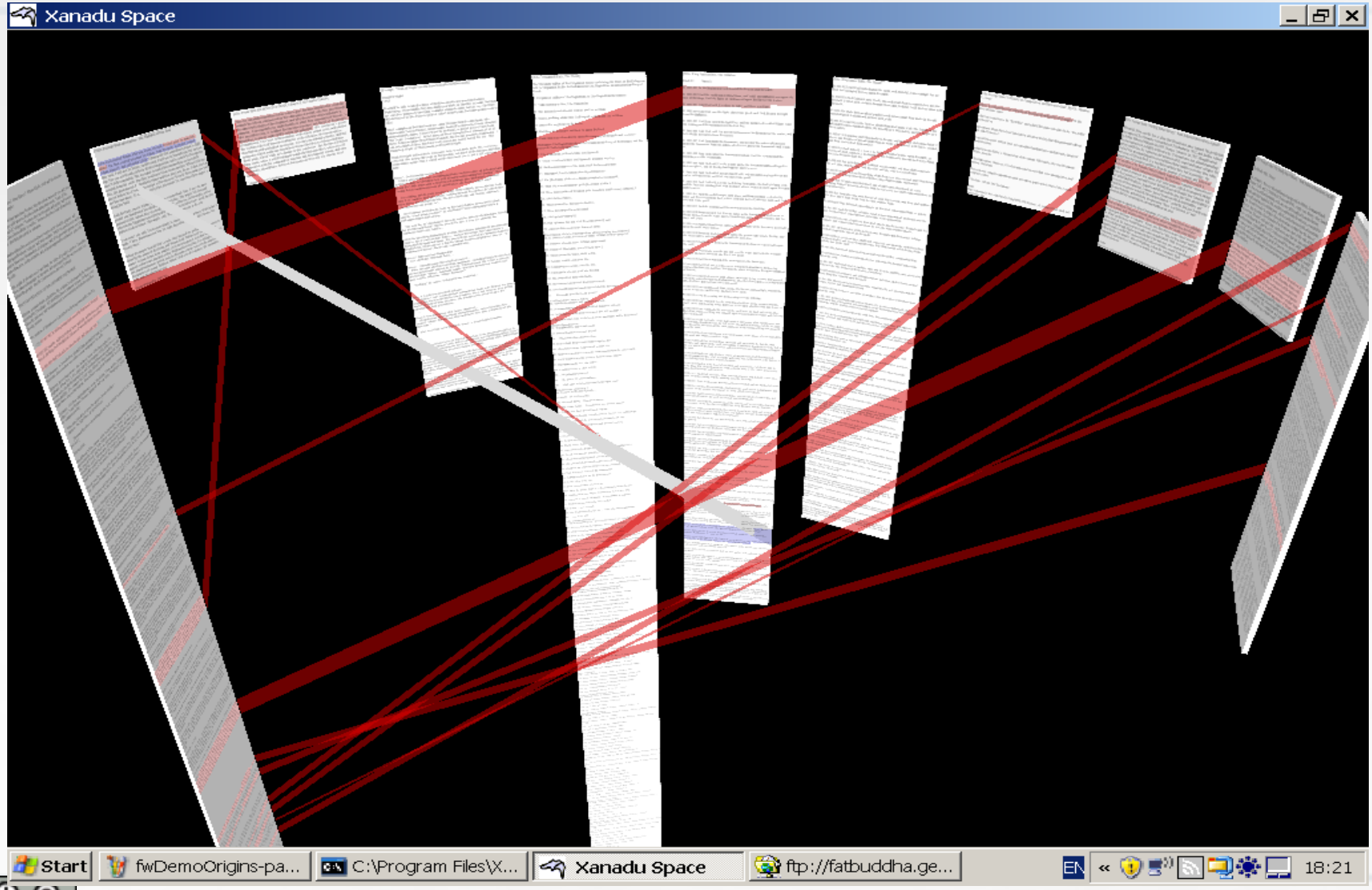
The end of the print paradigm

Web Based Scholarly Working Continuum ...
… a triple paradigm shift: Beyond Documents



- Decreasing functional determination by traditional cultural techniques
- Disintegration of the linear / circular functional paradigma
- Erosion of the monolithic document notion in hypertext paradigms

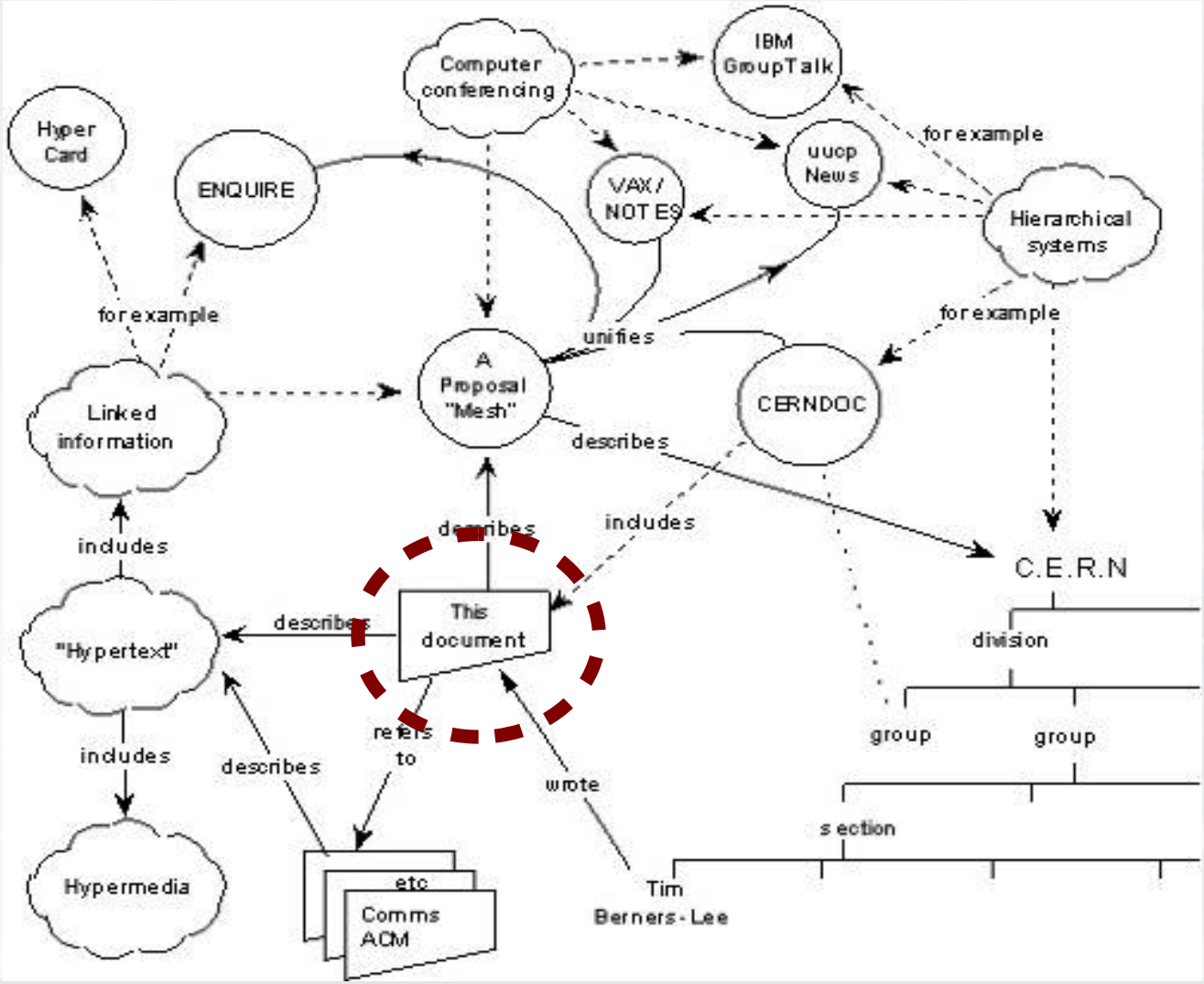
Ted Nelson's Xanadu: radicalised Hypertext ...



Transformation of the Document Web

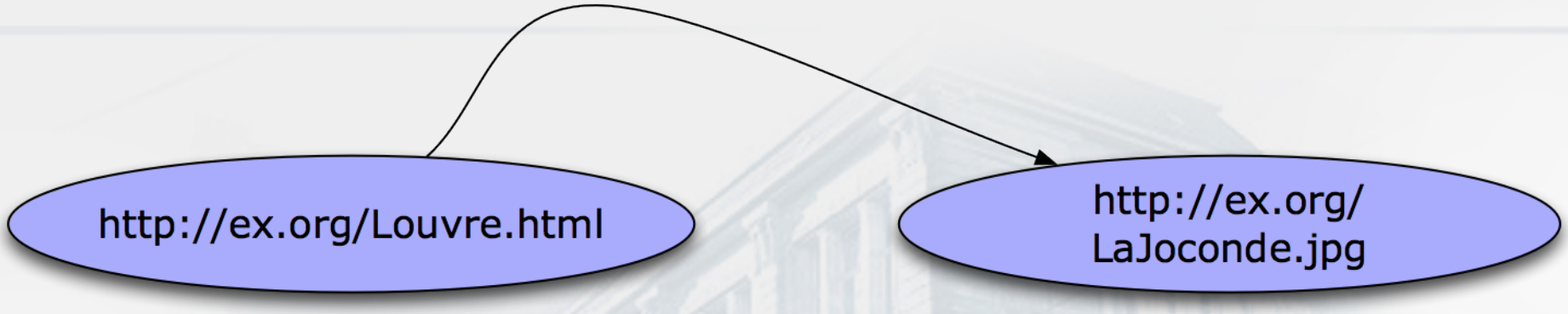
Extensions in Syntax and Scope

The Web of Documents



Information Management: A Proposal (TBL, 1989)

Resources and Links in the Document Web

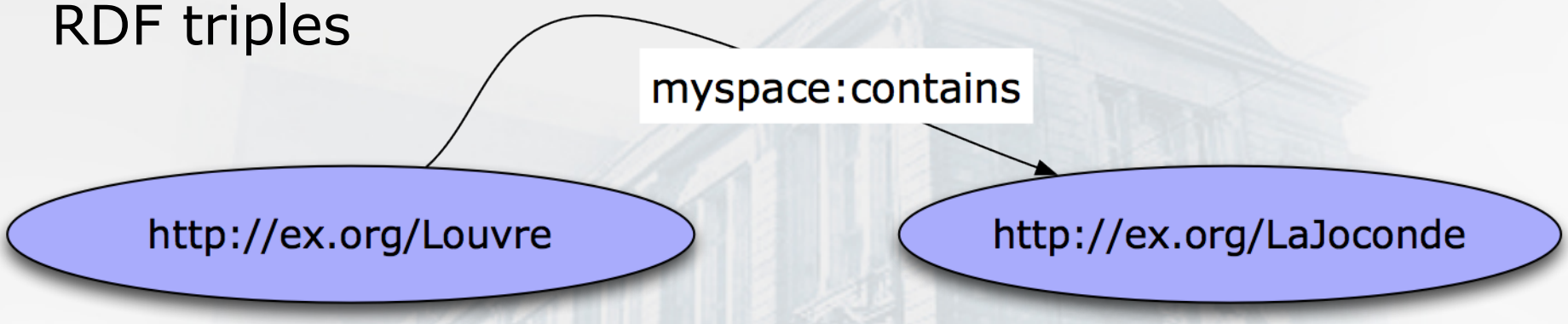



```
<a href="http://ex.org/LaJoconde.jpg">b</a>
```

- We have HTTP URIs to identify resources and links between them – but we are missing a few things!
- What kinds of resources are 'Louvre.html' and 'LaJoconde.jpg'?
  - A machine cannot tell.
  - Humans can: we recognise implied context!
- How exactly do they relate to each other?
  - A machine cannot tell.
  - Humans can: again we recognise implied context!

Syntactically Extending the Document Web (1)

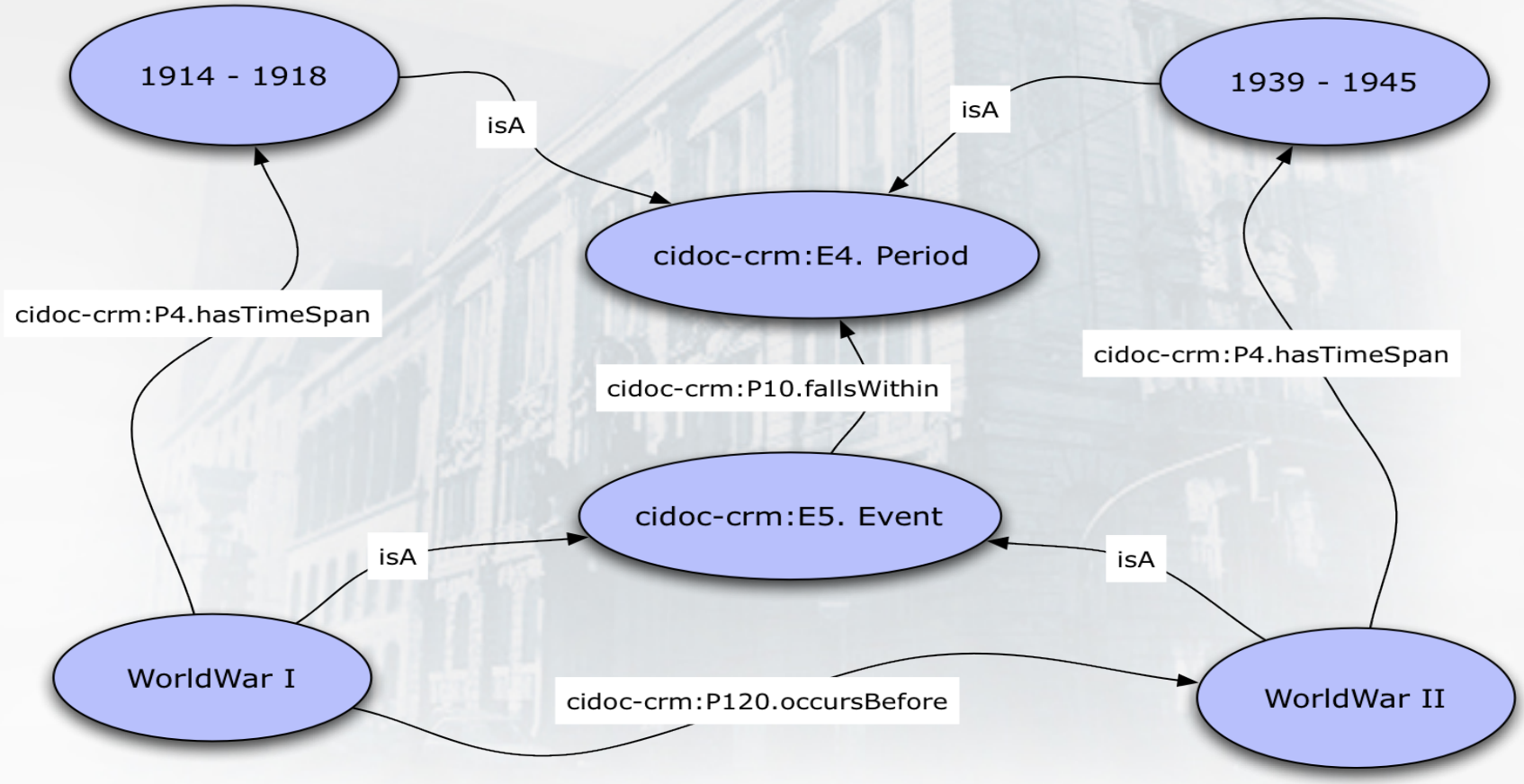
- We add a syntax for making statements on resources: RDF triples



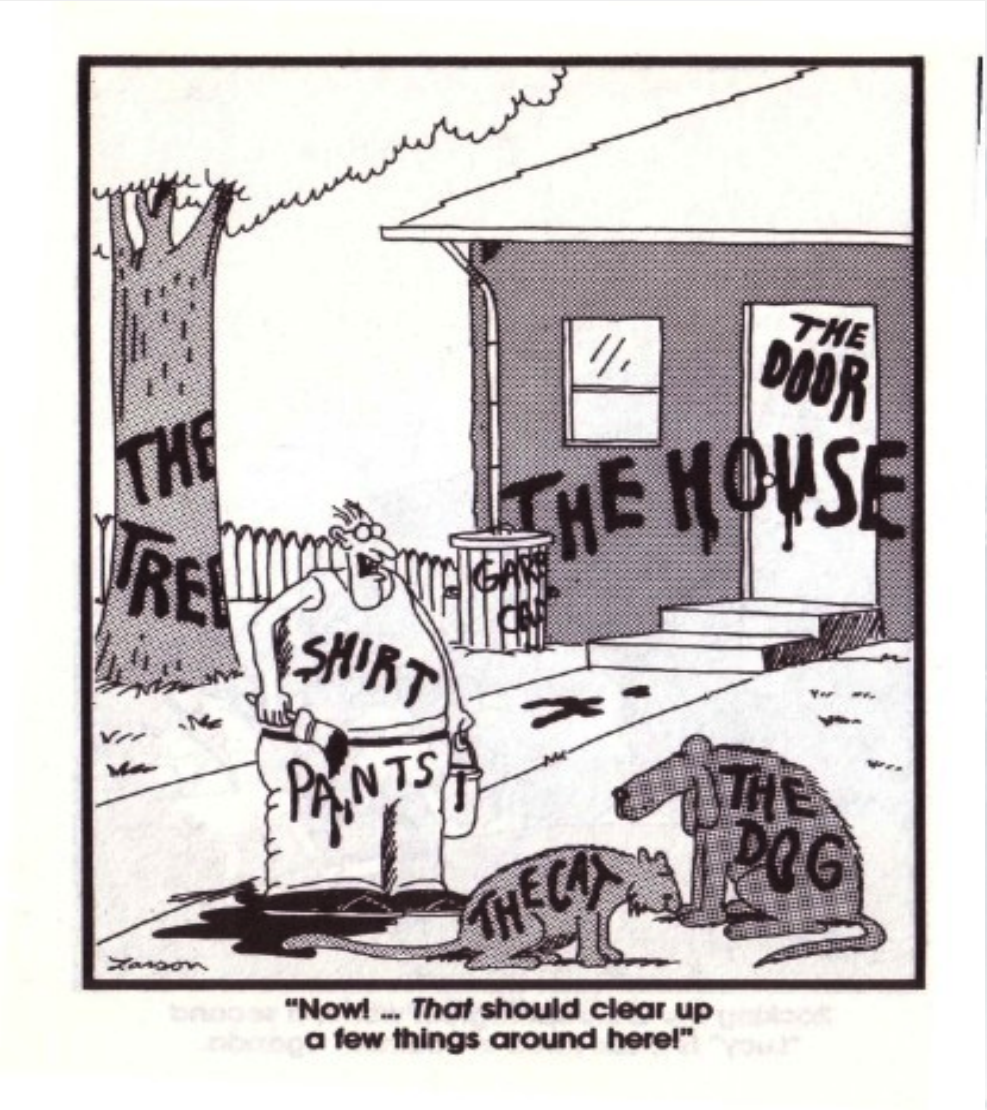
- We add a schema language (RDFS) with elements such as
  - classes (chair' as instance of chairs),
  - hierarchies of classes and properties (chairs are a subclass of furniture, 'teaches' is a sub-property of 'communicates')
  - inheritance (communication based on language → teaching also is)
  - support for basic inferencing.

Syntactically Extending the Document Web: RDF (2)

- And thus are able to establish structures in triple aggregations resulting in lightweight domain ontologies:



Extending the Web in Scope: The Web of Things … (slightly Mistaken)

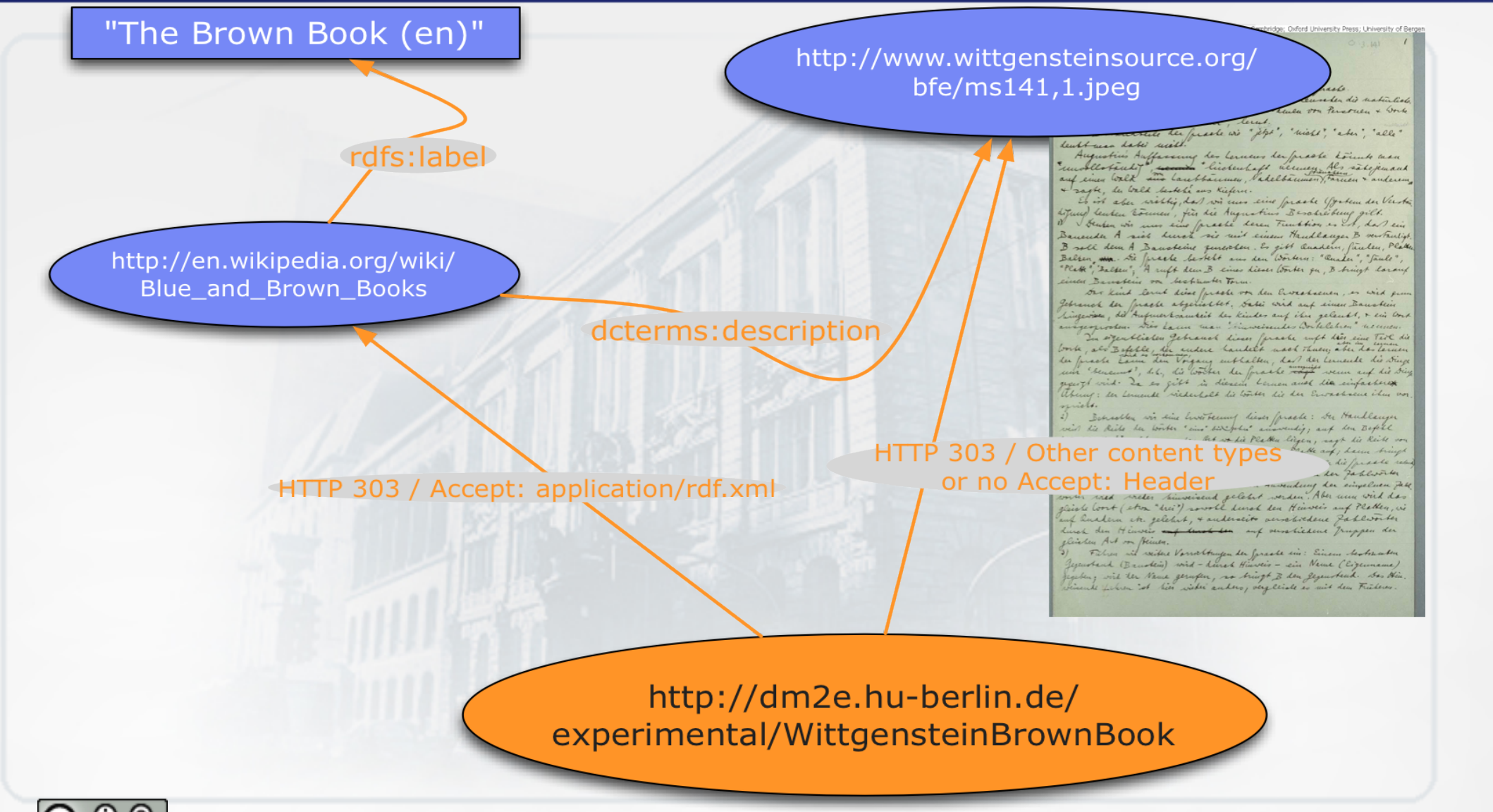


"Now! ... *That* should clear up a few things around here!"

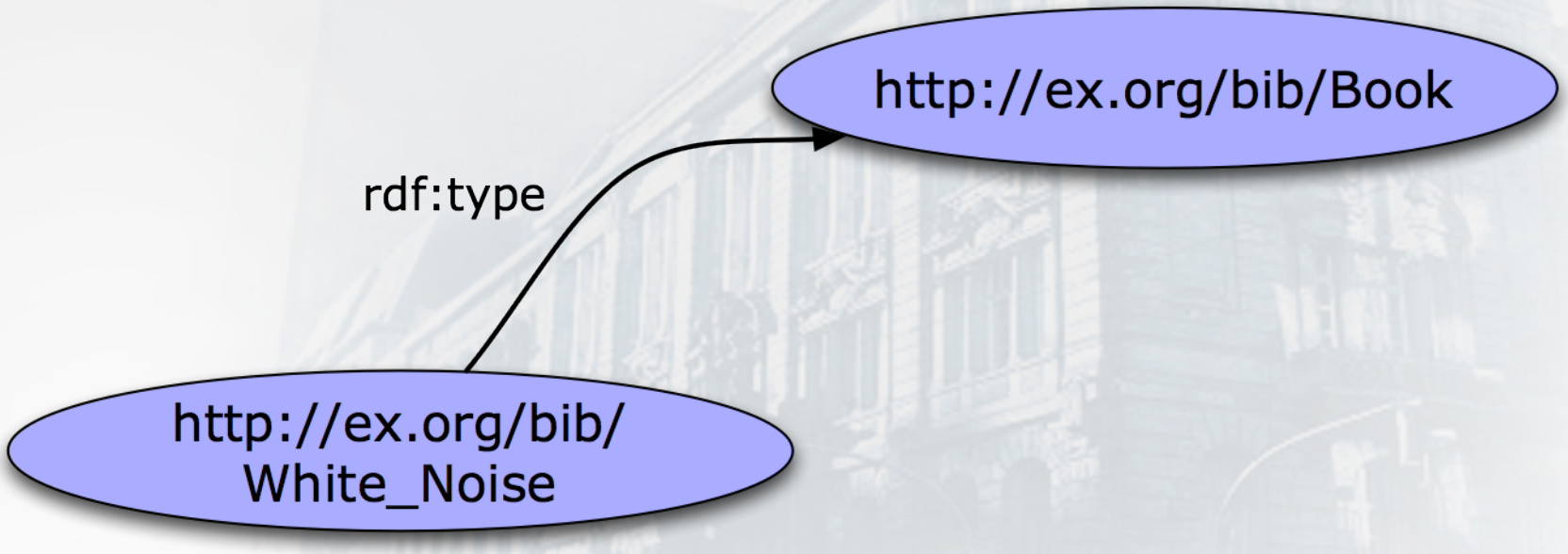
What's **wrong** with this picture?

Taken from Ronald Carpentier's Blog at http://carpentier.wordpress.com/2007/08/08/1-2-3/

… and the Way we extend the Web in scope to make it a 'Web of Things'

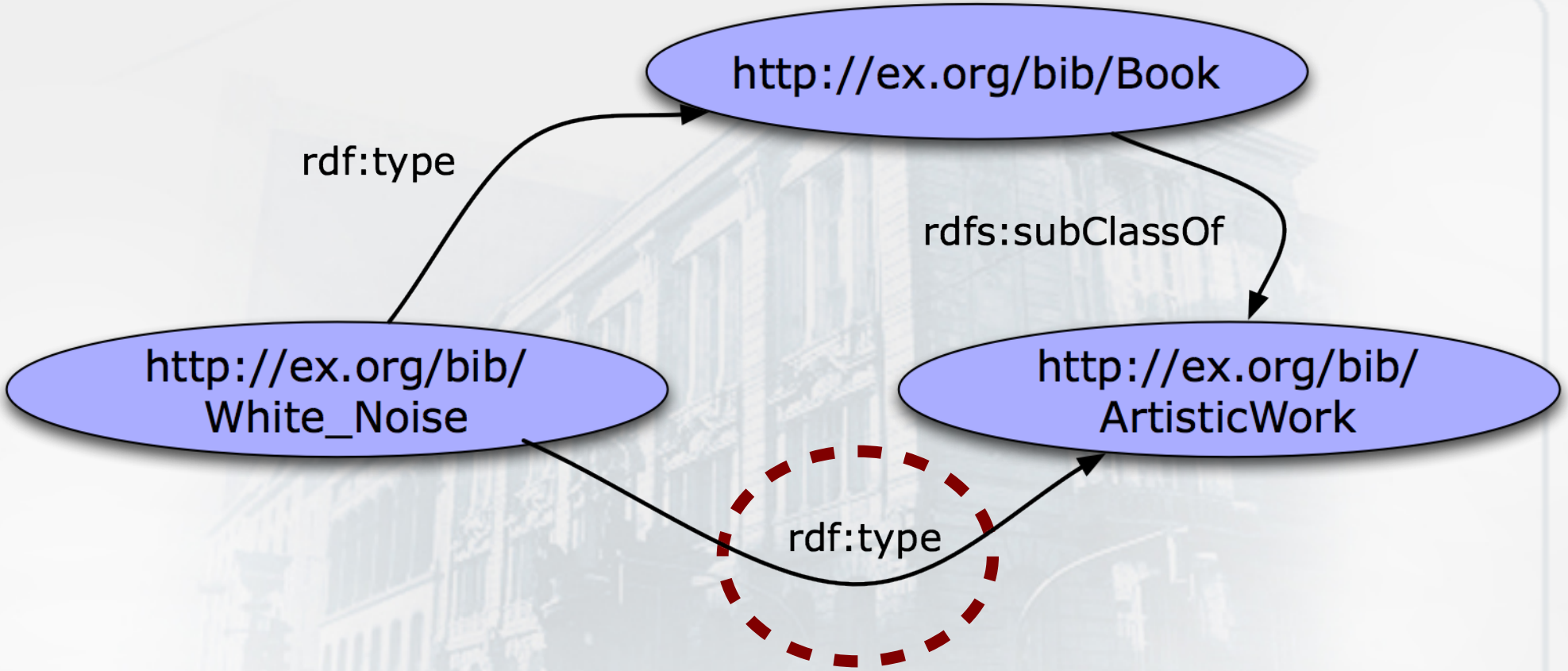


Machines can reason on triple sets!



Some reasoning preconditions ...

… and an automated inference!

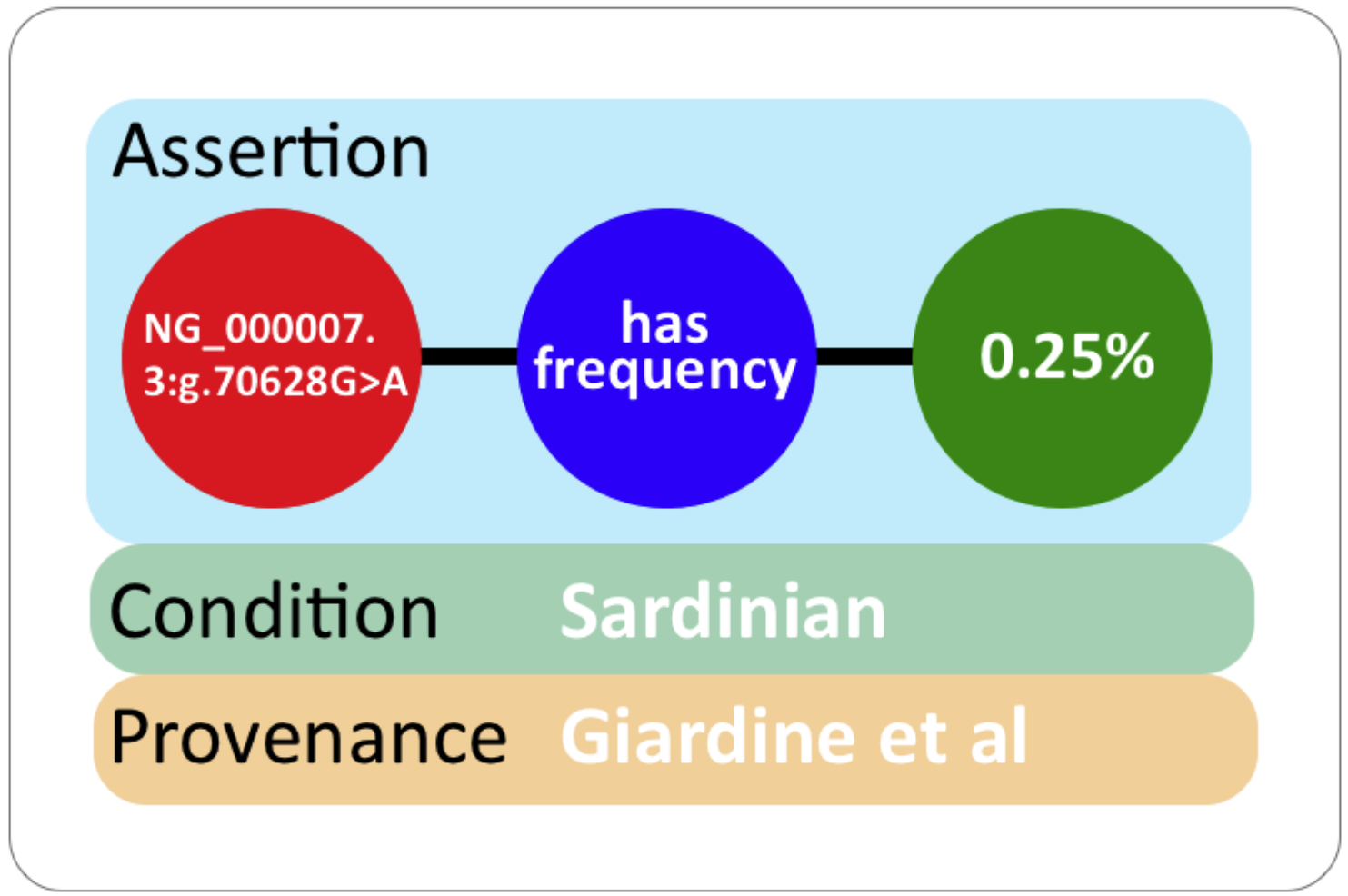


There is quite some potential for generating scholarly heuristics here!

Documents, Data and Scholarship

… into content, into context!

... based on 'Documents' as Aggregations of RDF-Triples (1)



'Documents' as Aggregations of RDF-Triples (2)

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The use of Inferences

Citation: van Haagen HHHBM, 't Hoen PAC, Botelho Bovo A, de Morrée A, van Mulligen EM, et al. (2009) Novel Protein-Protein Interactions Inferred from Literature Context. PLoS ONE 4(11): e7894. **doi:10.1371/journal.pone.0007894 / Example provided by Jan Velterop**

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RESEARCH ARTICLE OPEN ACCESS

Novel Protein-Protein Interactions Inferred from Literature Context

Article Metrics Related Content Comments: 0

Herman H. H. B. M. van Haagen[1*], Peter A. C. 't Hoen[1], Alessandro Botelho Bovo[2], Antoine de Morrée[1], Erik M. van Mulligen[1], Christine Chichester[1], Jan A. Kors[1], Johan T. den Dunnen[1], Gert-Jan B. van Ommen[1], Silvère M. van der Maarel[1], Vinícius Medina Kern[2], Barend Mons[1], Martijn J. Schuemie[1]

1 Biosemantics Association, Department of Human Genetics, Leiden University Medical Center, Leiden, and Department of Medical Informatics, Erasmus University Medical Center, Rotterdam, The Netherlands, **2** Post-Graduate Program in Knowledge Engineering and Management (EGC), Federal University of Santa Catarina (UFSC), Florianópolis, Brazil

To **add a note**, highlight some text. Hide notes

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Author Contributions
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Abstract Top

We have developed a method that predicts Protein-Protein Interactions (PPIs) based on the similarity of the context in which proteins appear in literature. This method outperforms previously developed PPI prediction algorithms that rely on the conjunction of two protein names in MEDLINE abstracts. We show

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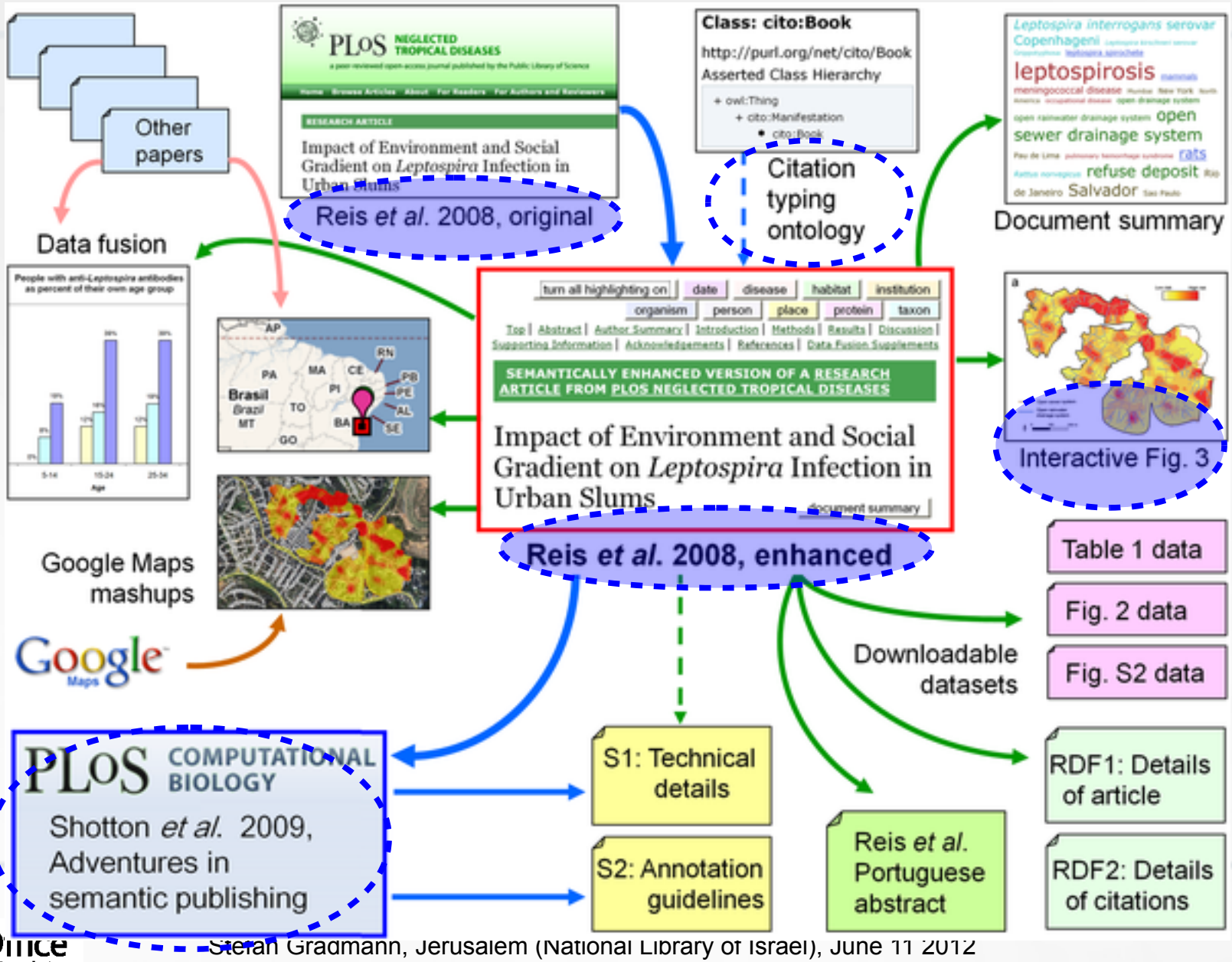
Semantic Publishing as Defined by Shotton

- Shotton et al. (2009b) define semantic publication to include anything that
  - **enhances the meaning** of a published journal article,
  - **facilitates** its automated **discovery**,
  - enables its **linking to semantically related articles**,
  - provides **access to data within the article** in actionable form, or
  - facilitates **integration of data between articles**.

Behind the Screen



Semantic Enrichment Tools

- Generic:
  - OpenCalais (http://www.opencalais.com/ → Thomson Reuters)
  - Temis (http://www.temis.com/)
  - Collexis (http://www.collexis.com/ → Elsevier)
- Specialised:
  - Bio Taxon Finder (http://www.ubio.org/index.php?pagename=xml_services)
  - ConceptWebAlliance (http://conceptwiki.org) (Biomedical, Jan Velterop)
- Shotton criticised by Roderic Page: http://iphylo.blogspot.com/2009/04/semantic-publishing-towards-real.
  - "linking terms to HTML pages doesn't get us much further. Great for humans, not so good for computers."
  - Too much focus on journal article format!
- → We need a little more! We need 'liquid documents'!!

Publications: "The Liquid Version"

"Turning inked letters into electronic dots that can be read on a screen is simply the first essential step in creating this new library. The **real magic** will come in the second act, as each word in each book is

- cross-linked,
- clustered,
- cited, extracted,
- indexed,
- analyzed,
- annotated,
- remixed,
- reassembled

and woven deeper into the culture than ever before. In the new world of books, every bit informs another; every page reads all the other pages."

Kevin Kelly, The New York Times Magazine, May 14, 2006

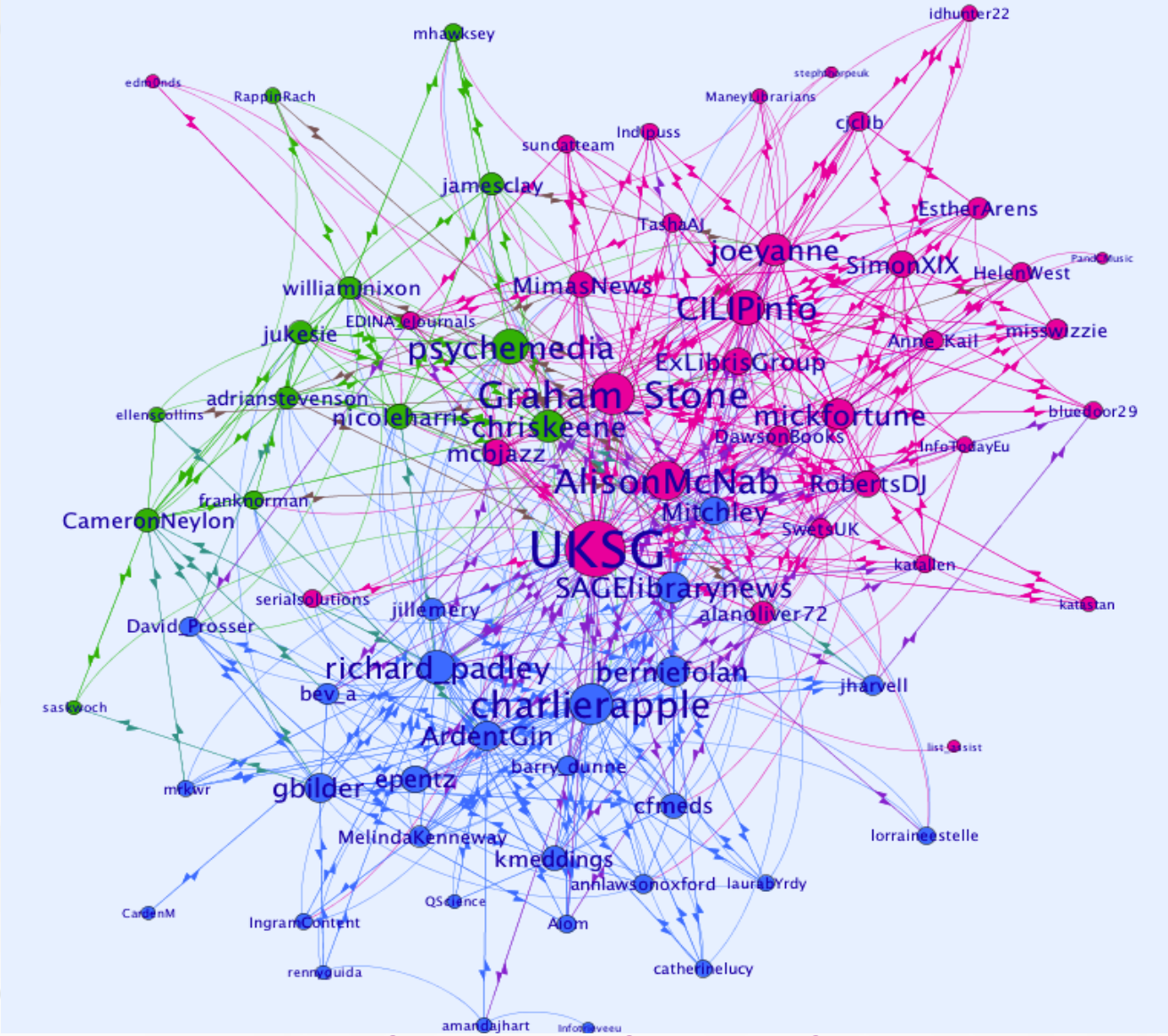
Digital Libraries: "The Liquid Version"

http://www.perseus.tufts.edu

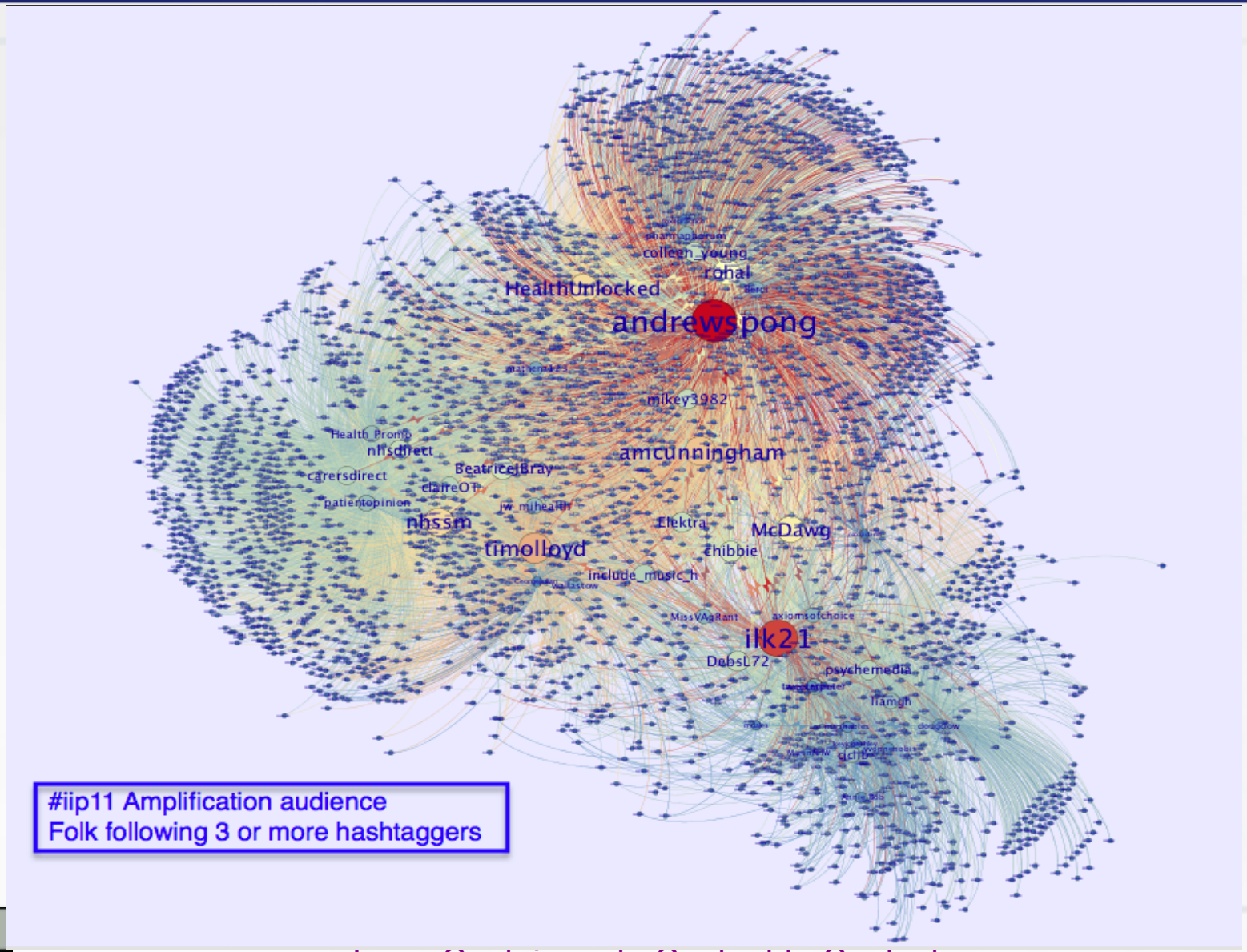
Data = Publication

- Distinction data vs. publication will get **increasingly obsolete** in semantic publishing environments …
- … at least in the STM sector.
- The move into semantic publication will be **somewhat slower in the SSH** because of
  - fuzzy and unstable **terminology**
  - fuzzy **linking semantics** hard to formalise consistently
  - close relation between **complex document formats** and **scholarly discourse**
- Current examples are mostly from the medical and bio-medical area as a consequence.

… visualise scholarly networks (1)



… visualise scholarly networks (2)



→ Visualise Cultural Context

Mapping the Republic of Letters:
https://republicofletters.stanford.edu/#maps

Or again a Finnish example (Kultuurisampo):
http://www.kulttuurisampo.fi/kulsa/historiallisetKartat.shtml

An Opportunity for Libraries …

… and what they need to change to be up to it

“What do you do with a million books?” (G. Crane)

- Digitisation and semantic publishing result in
  - growing quantity
  - increased complexity
- Well beyond scholarly processing capacity (=reading faculty)
- Multiplication of collections or distributors is annoying → as few as possible. Ideally just one (?)
- Scientists and Scholars will badly need help in :
  - **Semantic abstracting**, **named entity recognition** for “strategic reading” (Renear)
  - **Contextualisation** of information objects
  - Robust **reasoning and inferencing** yielding digital heuristics
- => ***Potential opportunities for libraries …***

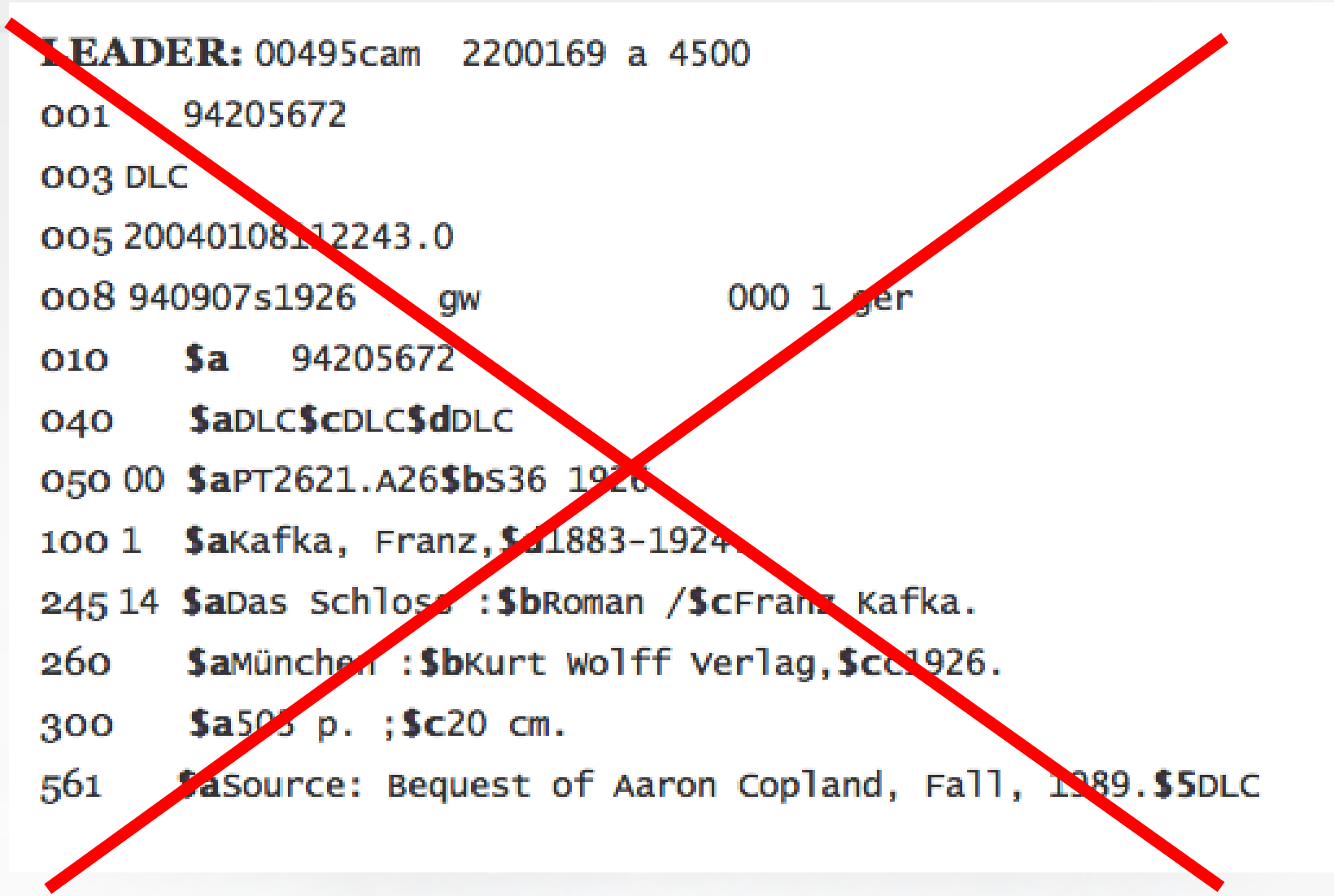
Ceci n'est pas une bibliothèque

Ceci n'est pas une bibliothèque

Catalogue

The card catalog in the nave of Sterling Memorial Library at Yale University. Picture by Henry Trotter, 2005.

Catalogue Entry: MARC Record



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008 940907s1926    gw              000 1 ger
010    $a   94205672
040    $aDLC$cDLC$dDLC
050 00 $aPT2621.A26$bS36 192
100 1  $aKafka, Franz,$d1883-1924
245 14 $aDas Schloss :$bRoman /$cFranz Kafka.
260    $aMünchen :$bKurt Wolff Verlag,$c1926.
300    $a505 p. ;$c20 cm.
561    $aSource: Bequest of Aaron Copland, Fall, 1989.$5DLC
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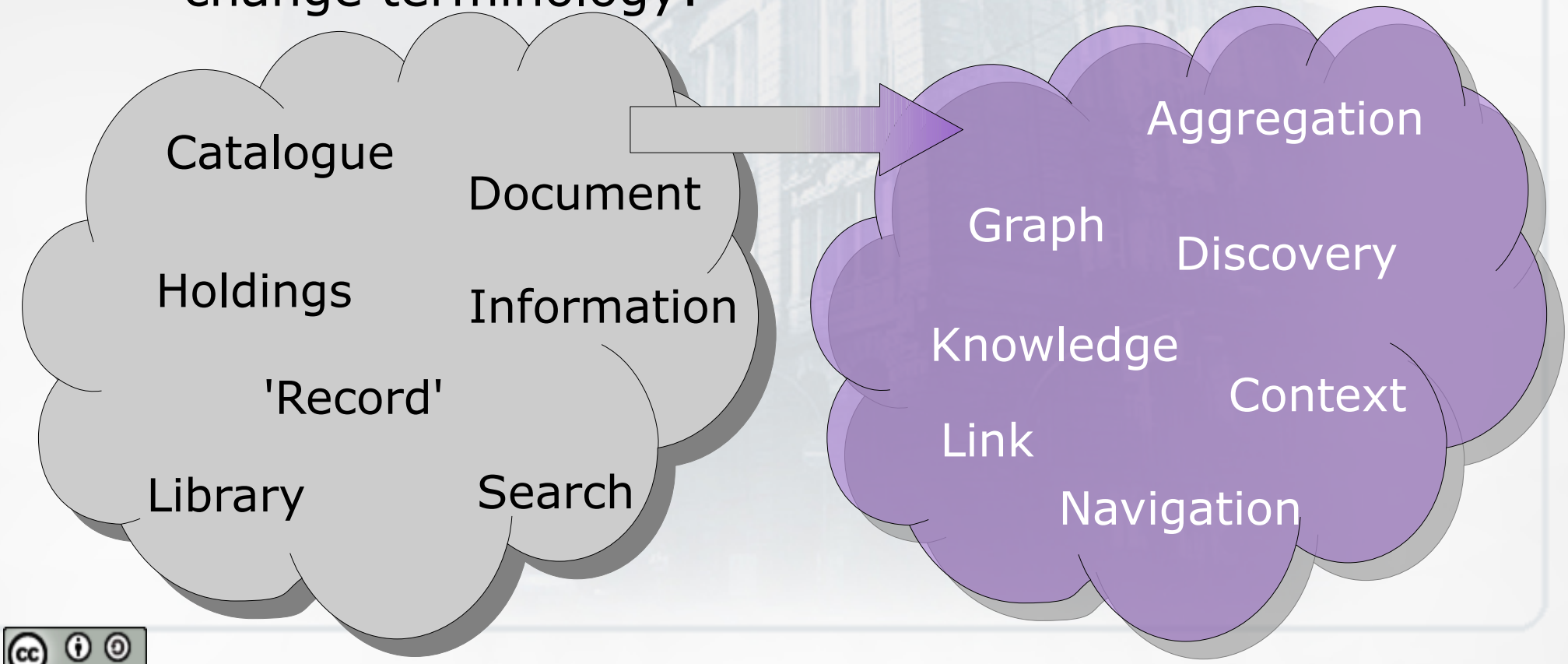
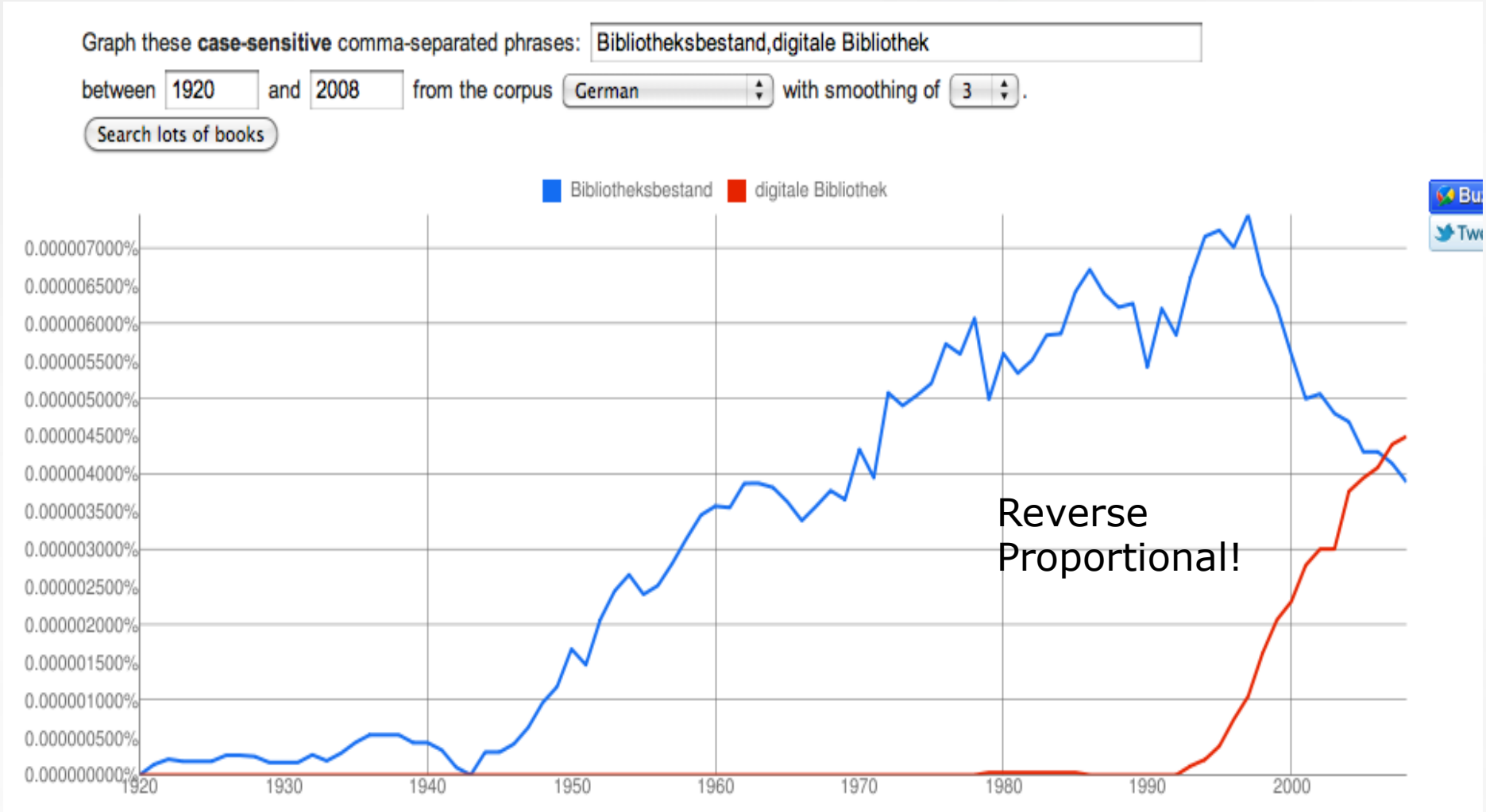
'Library Collections'

Change Terminology!

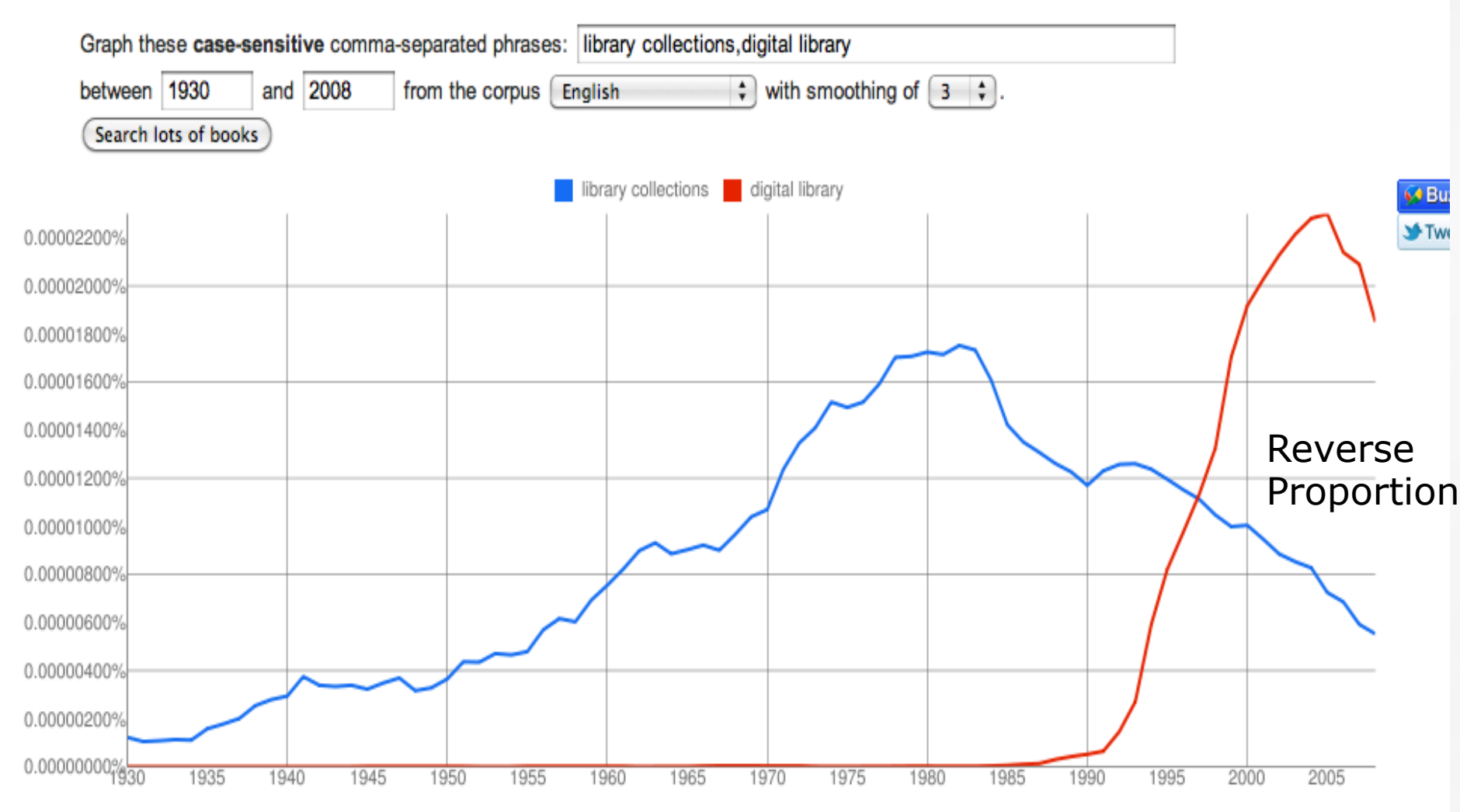
- Libraries will serve research as part of the Linked Open Data web – or else risk becoming insignificant.
- For operating this change they definitely need to change terminology:



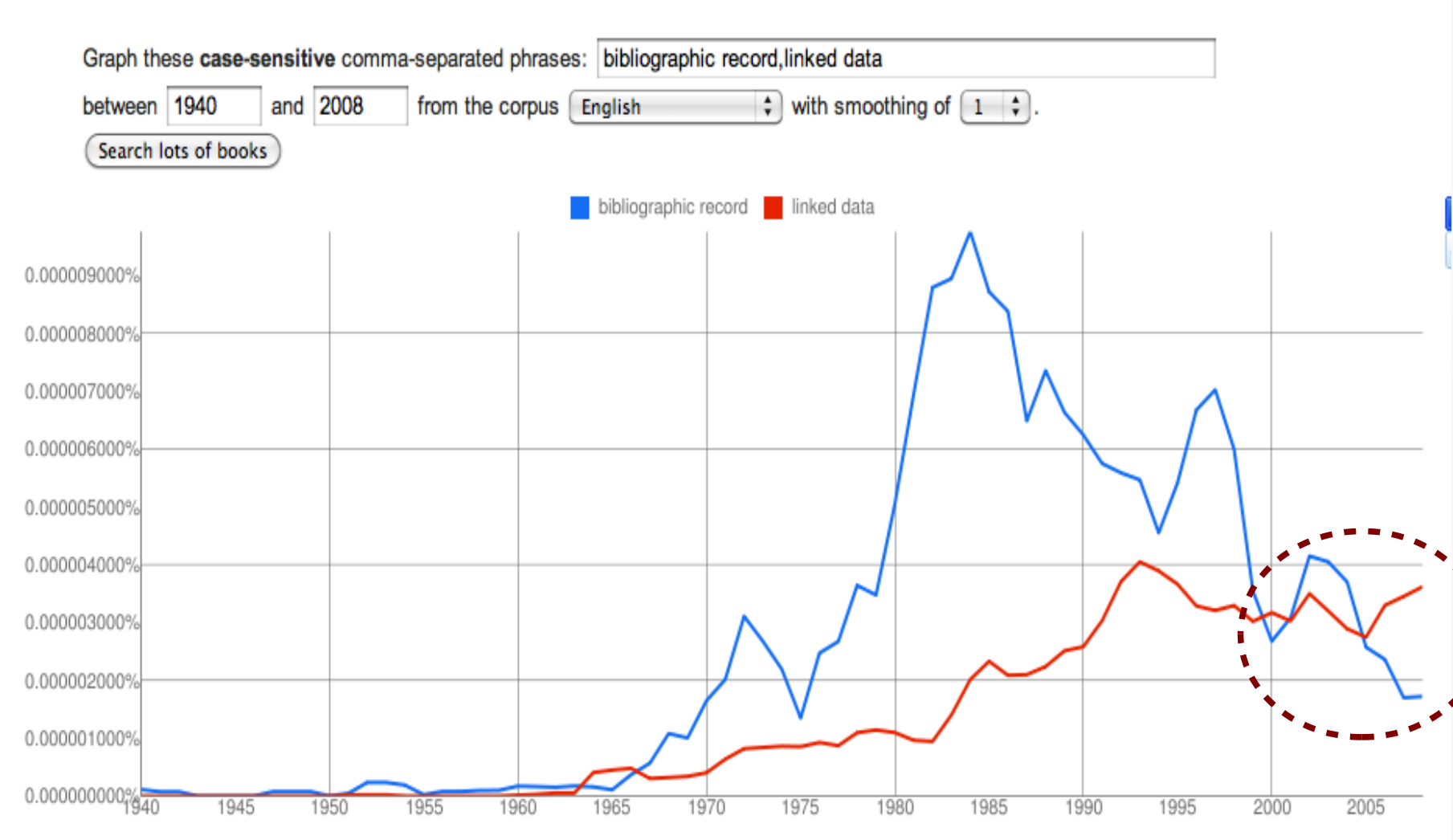
From 'Catalogues' to 'Graphs': old terms – new terms (1)



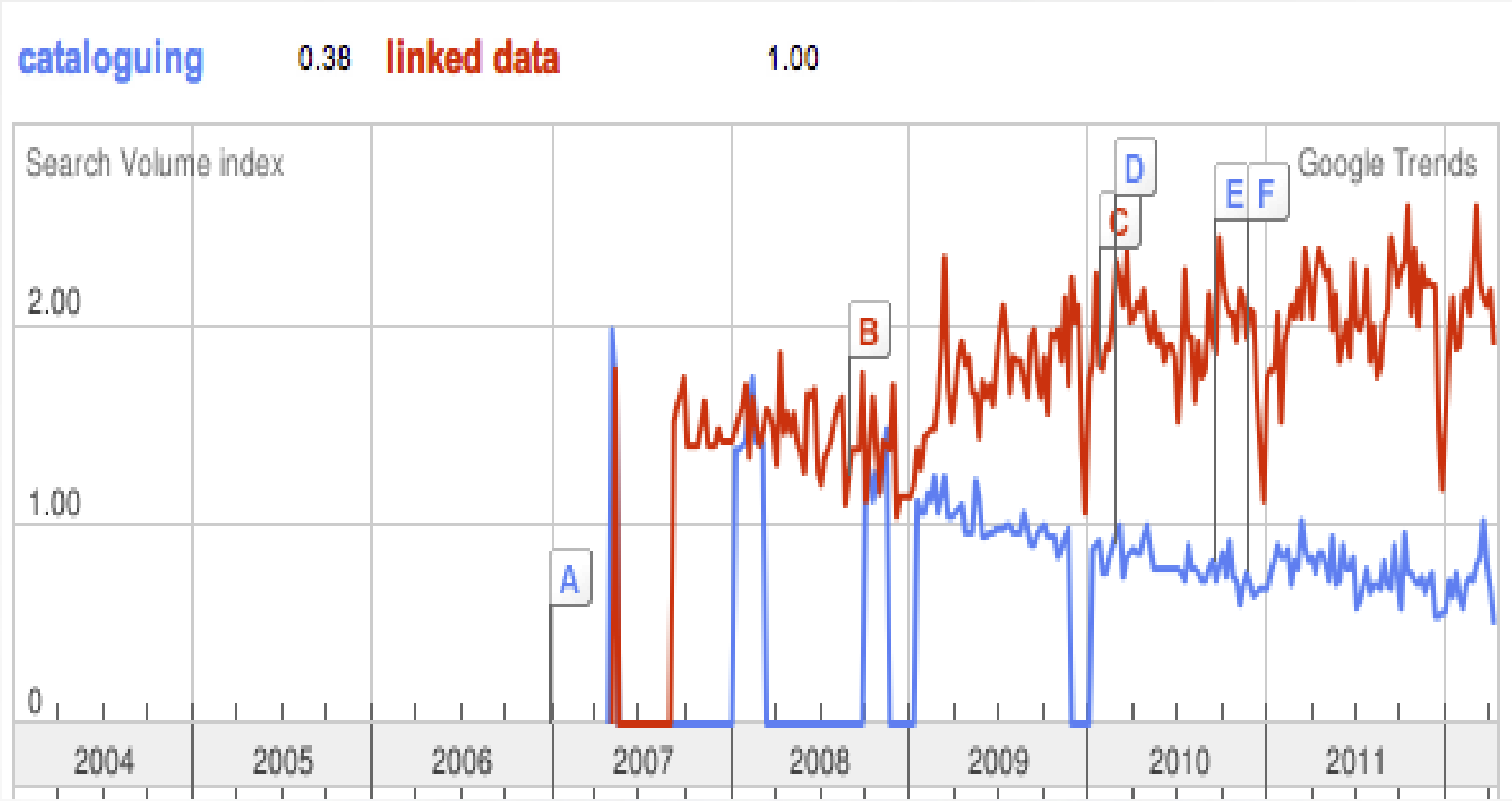
From 'Catalogues' to 'Graphs': old terms – new terms (2)



From 'Catalogues' to 'Graphs': old terms – new terms (3)



From 'Catalogues' to 'Graphs': old terms – new terms (4)



Sticking to empty metaphors ...

"What's in a name? That which we call a rose
By any other name would smell as sweet."
(Shakespeare, Romeo and Juliet (II, ii, 1-2))

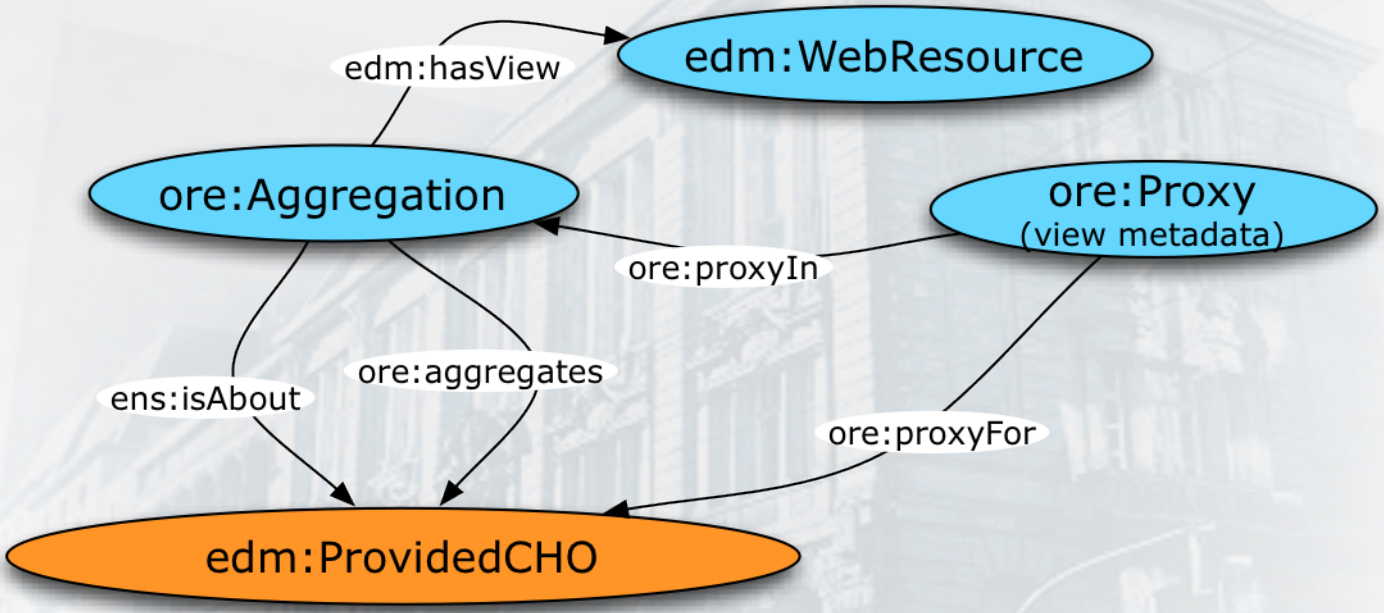
- Why then do we stick to emptied metaphors?
- … because they **constitute identity** (a very bad reason!)
- … because they guarantee **institutional persistency** (a fallacy!)
- … because we are afraid of substantial changes and believe in **things changing only once we use new terms** (dangerously childish!)
- … or simply because **we do not have new terms** yet?

Let us then start looking for them!

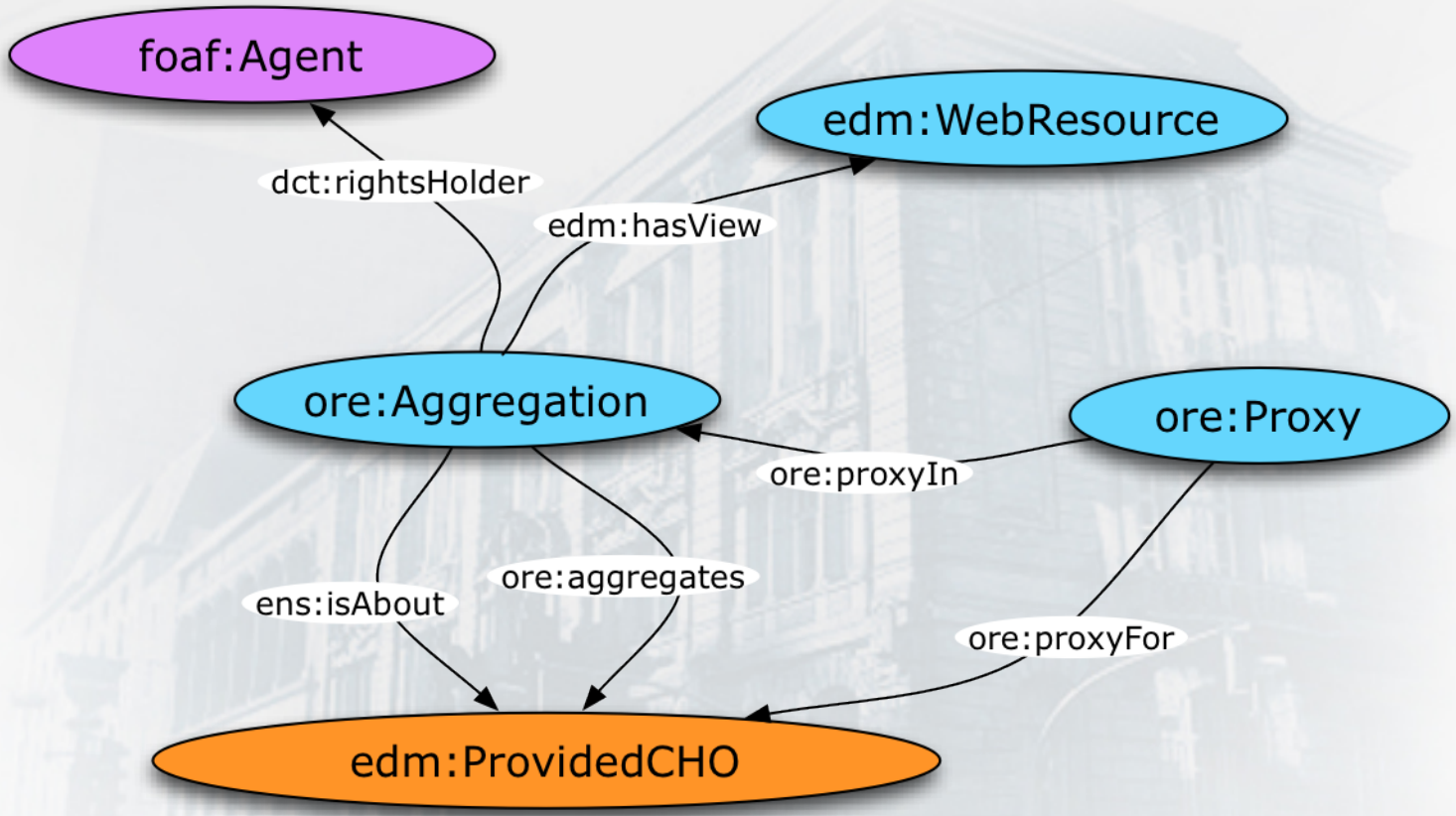
Lessons learned in Europeana

- We have learned some of these lessons in Europeana
  - we dropped the brand “EDL” very early
  - we decided not to have a 'catalogue'
- We know that the current portal is not enough
  - we devised the RDF based Europeana Data Model (EDM)
  - we are gradually migrating to EDM based operations
  - we make Europeana part of the Linked Open Data cloud

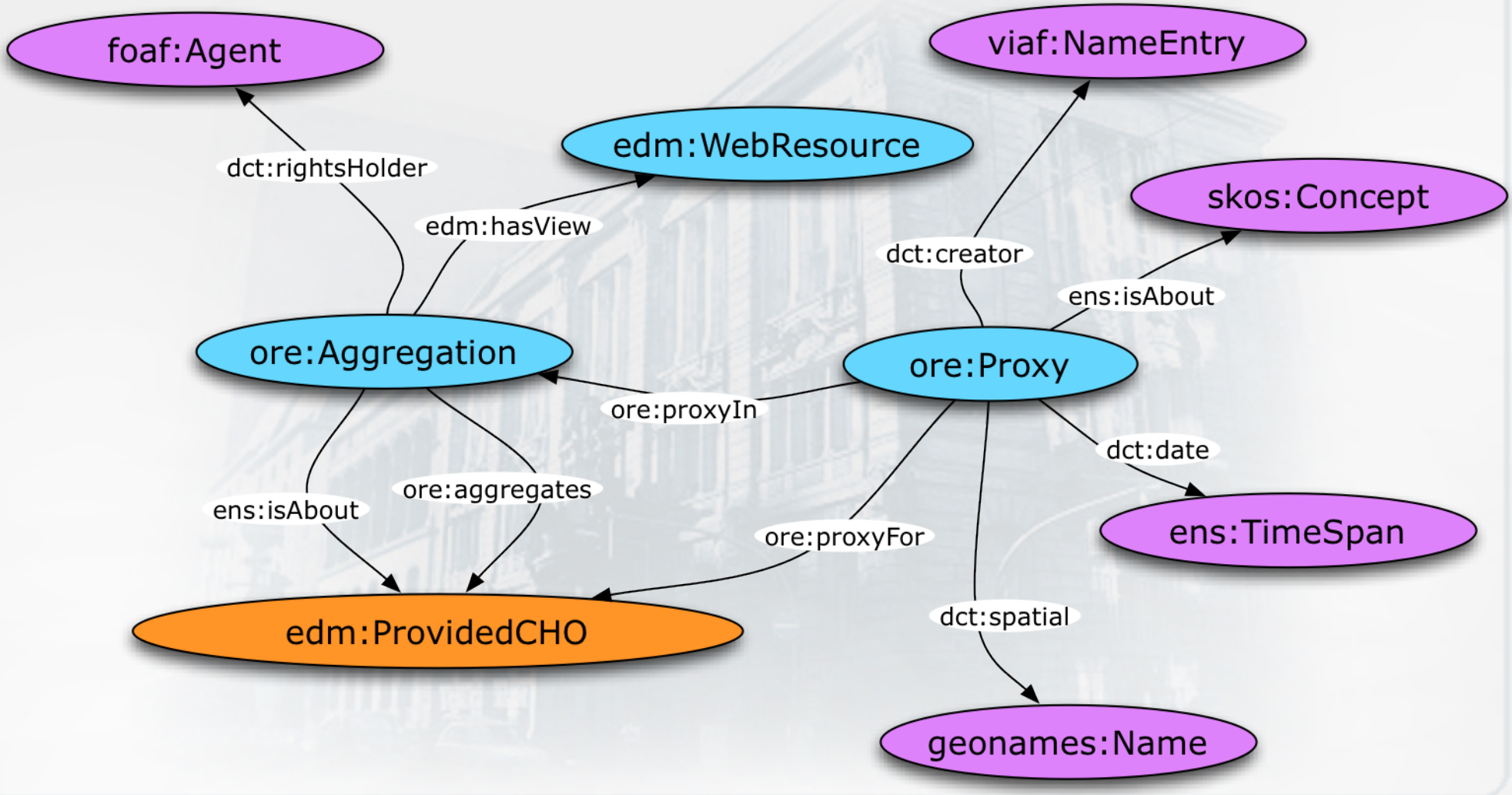
An Aggregation ...



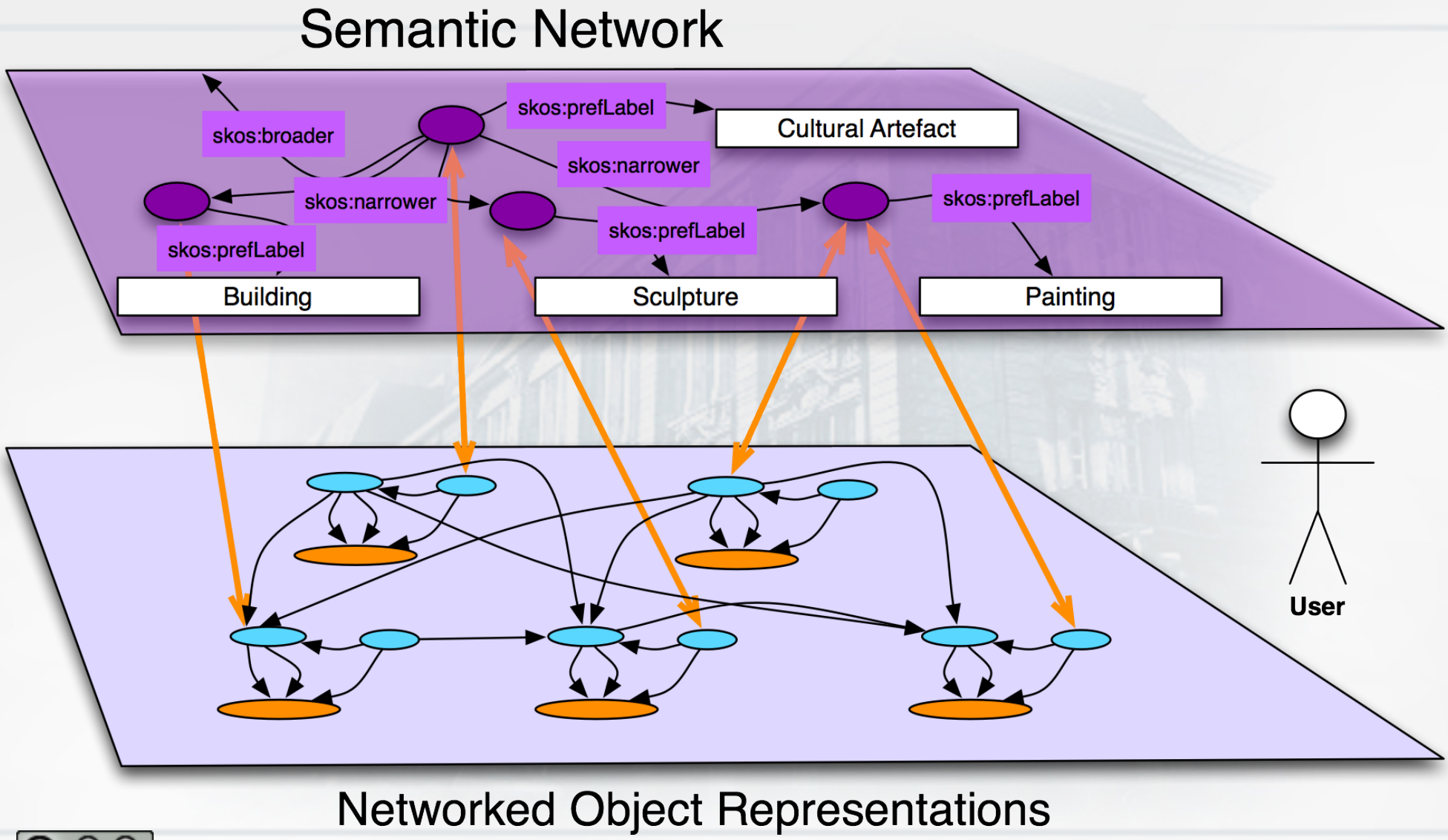
… some context



… more context



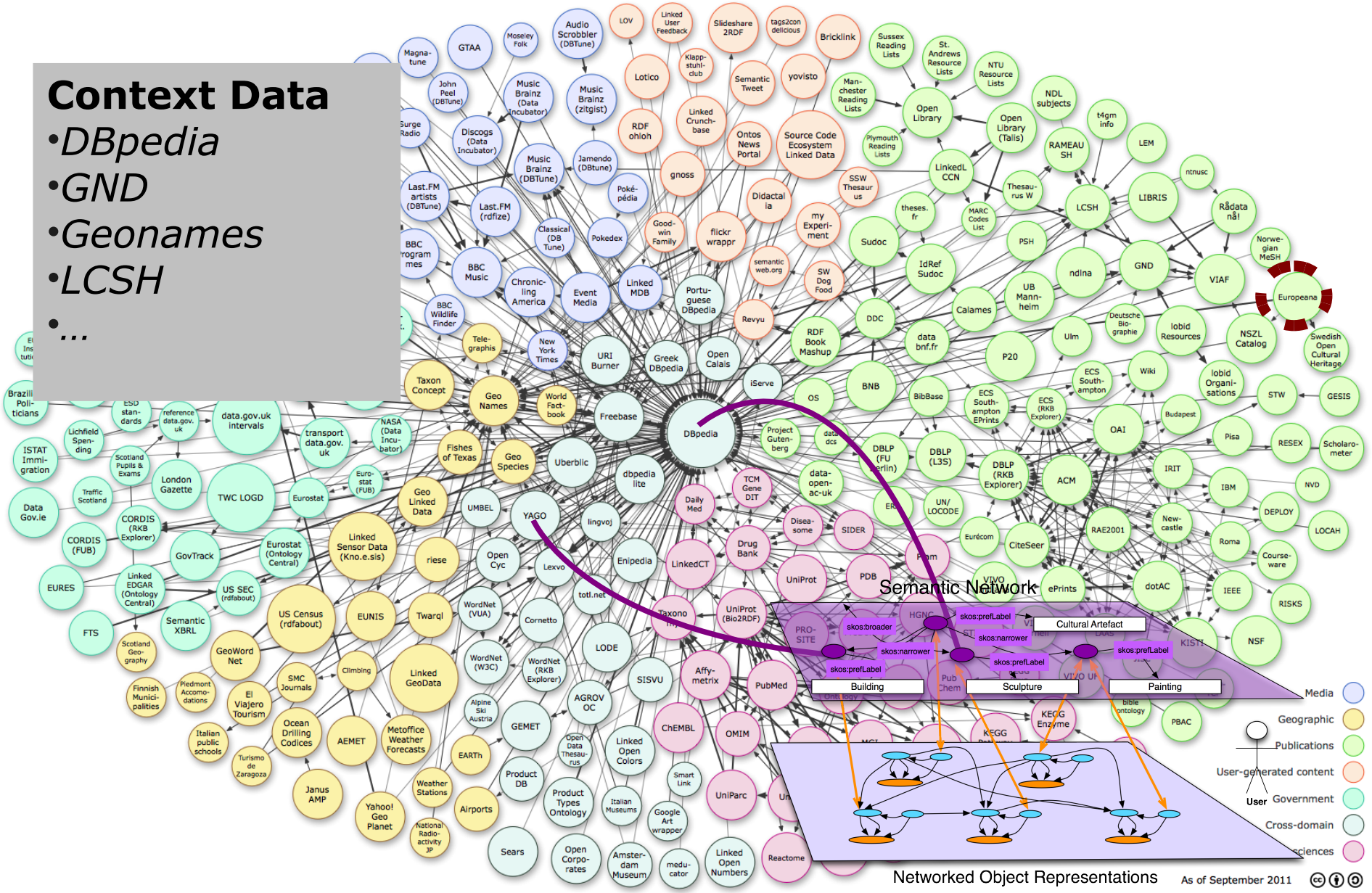
… and the Big Picture: Object and Semantic Data Layer



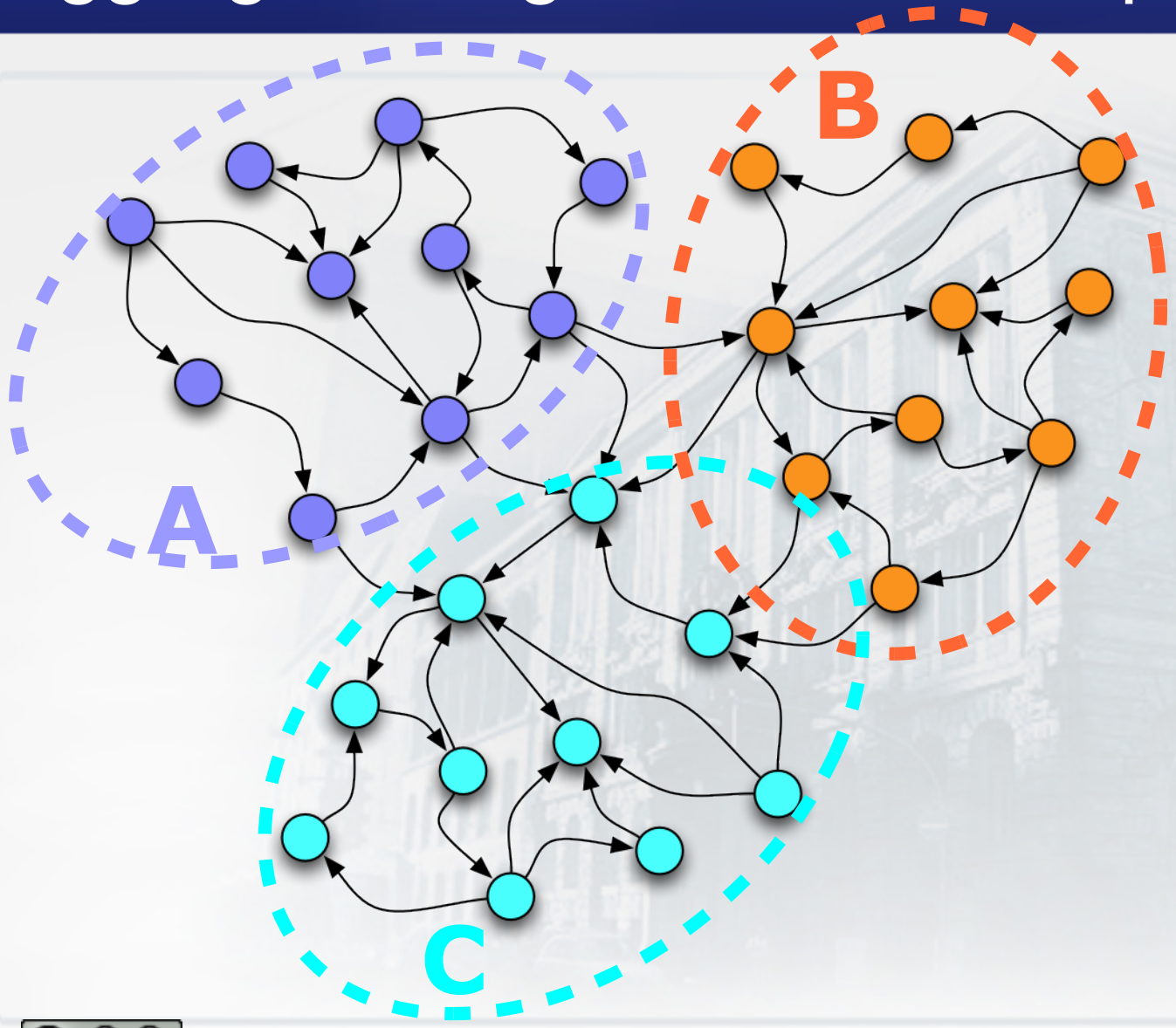
EDM and Linked Open Data

Context Data

- *DBpedia*
- *GND*
- *Geonames*
- *LCSH*
- *...*

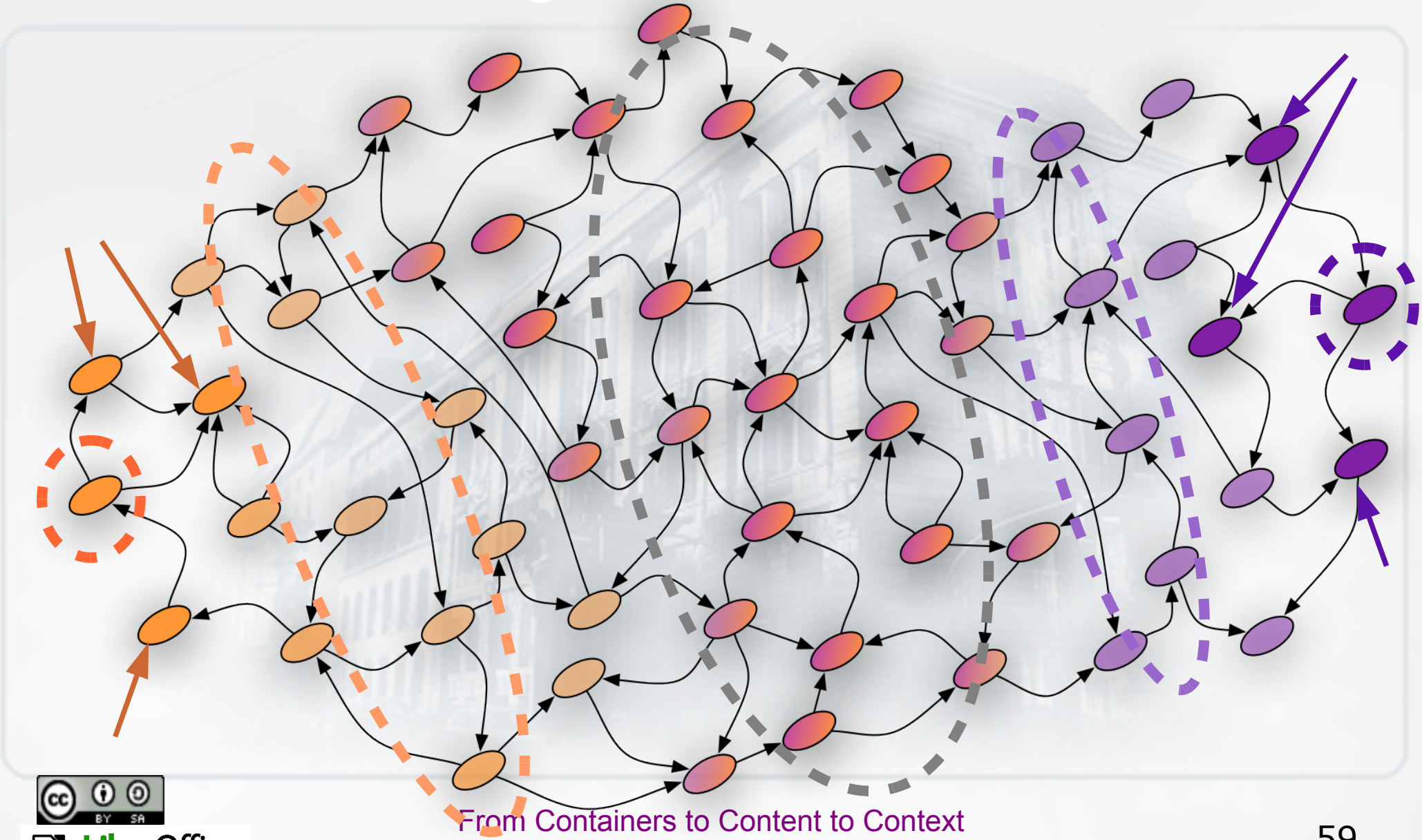


Modelling Object Representations as RDF Aggregations generates new questions ...



- Where do resource aggregations 'start'? Where do they 'end'?
- And what constitutes document boundaries??
- And which node was connected to which one at a given time???

Aggregations and Context: Calculating Closeness



With further deployment of the EDM
we gradually move … into Knowledge:
dealing with signification, relevance and 'value'

Significance, Relevance, Memory
“Access creates relevance” (Haim Gertner)

- We're back to Plato's “Phaidros”: But the 'Pharmakon' now is the Web! → What constitutes memory?
- Axioms for building 'Memory Institutions'
  - *Aggregation* and *selection* together create memory (Arno Schmidt and his “memory made of cast iron”).
    - *Signification* is more than just using names for things.
    - *Significance* (= relevance?) is built on signification.
    - *Knowledge* is *information* in *context*.
- → Preserving and transferring *knowledge* requires professional handling of *information* and *context* (→ RDF).
- → Any scholarship is built on the *fluidity of knowledge*, the *richness of signification*, the *dynamics of 'understanding'*.
- This is where I could start another talk on http://dm2e.eu

Suggested Reading

Gregory Crane (2006): What Do you Do with a Million Books? In: Dlib Magazine, Vol. 12, March. (http://bit.ly/JhzF90)

Gutenberg Paranthesis Research Group / University of Southern Denmark: Position Paper (http://bit.ly/JjGKb6)

David Parry: Burn the Boats/Books. Presentation to Digital Writing and Research Lab, Austin. (http://bit.ly/JYLlJV)

David Shotton (2009a): Semantic Publishing. The coming revolution in scientific journal publishing. Learned Publishing Volume 22, No 2, 85–94, April 2009; doi:10.1087/2009202

David Shotton et al. (2009b): Adventures in Semantic Publishing: Exemplar Semantic Enhancements of a Research Article (http://bit.ly/IgT5Km)

Barend Mons, Jan Velterop: Nano-Publication in the e-science era (http://bit.ly/IISMGt)

Alan Renear, Carol Palmer (2009): Strategic Reading, Ontologies and the Future of scientific Publishing. In: Science, August 2009, p. 828 – 832.

Gradmann, S. (2010). Knowledge = Information in Context : on the Importance of Semantic Contextualisation in Europeana. http://www.scribd.com/doc/32110457/Europeana-White-Paper-1

Thank you for your patience and attention